Winter Service Number

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MOTOR AGE

Vol. XLII
Number 18

PUBLISHED WEEKLY AT THE MALLERS BUILDING
CHICAGO, NOVEMBER 2, 1922

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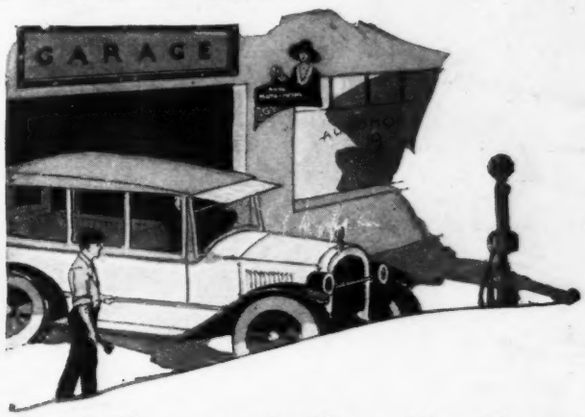

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The SPECIALIZED vehicle is recognized as standard

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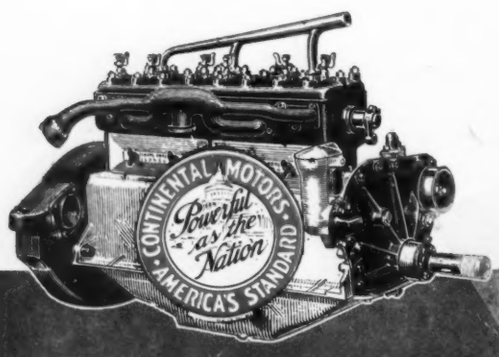

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MOTOR AGE

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SPRING LUBRICATOR
[Patented April 18, 1911-April 13, 1915]
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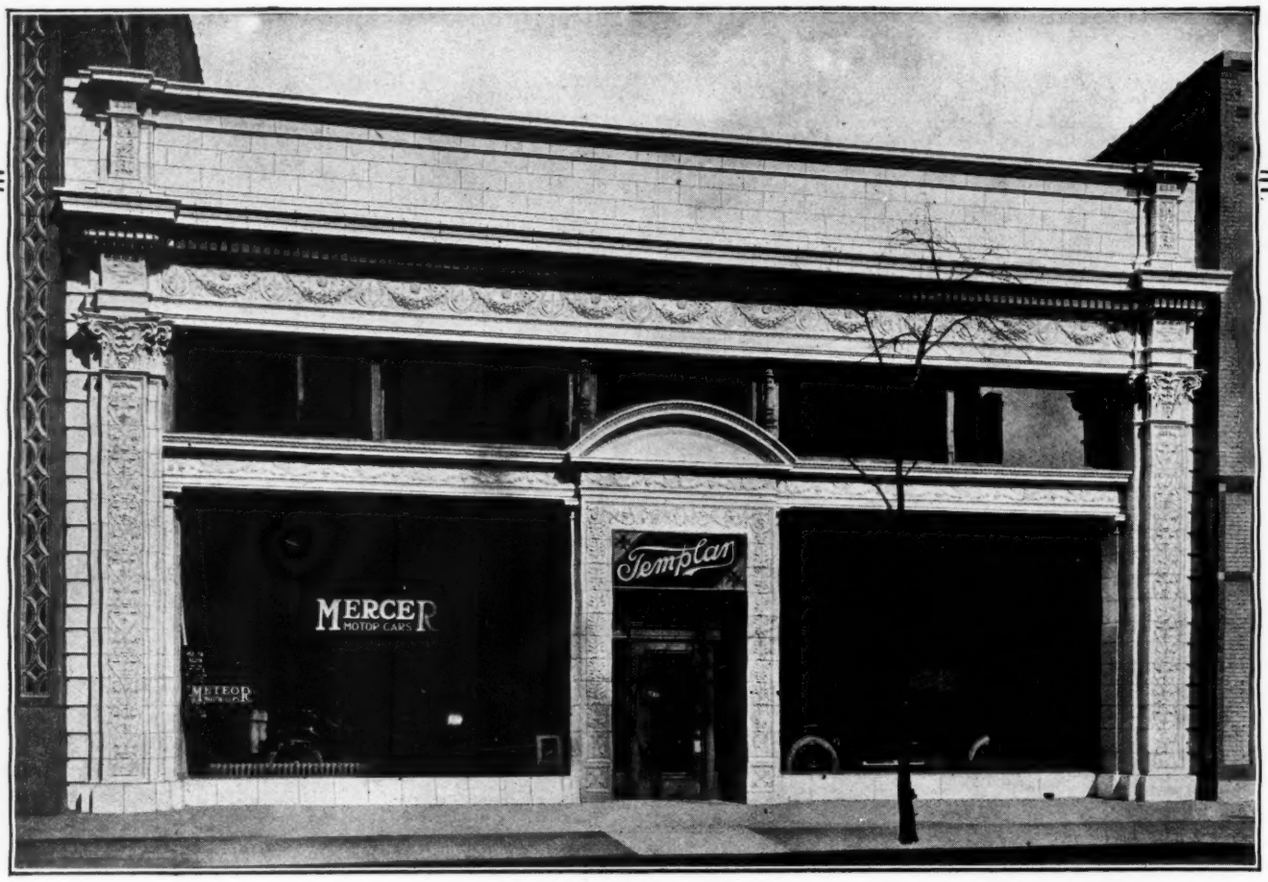

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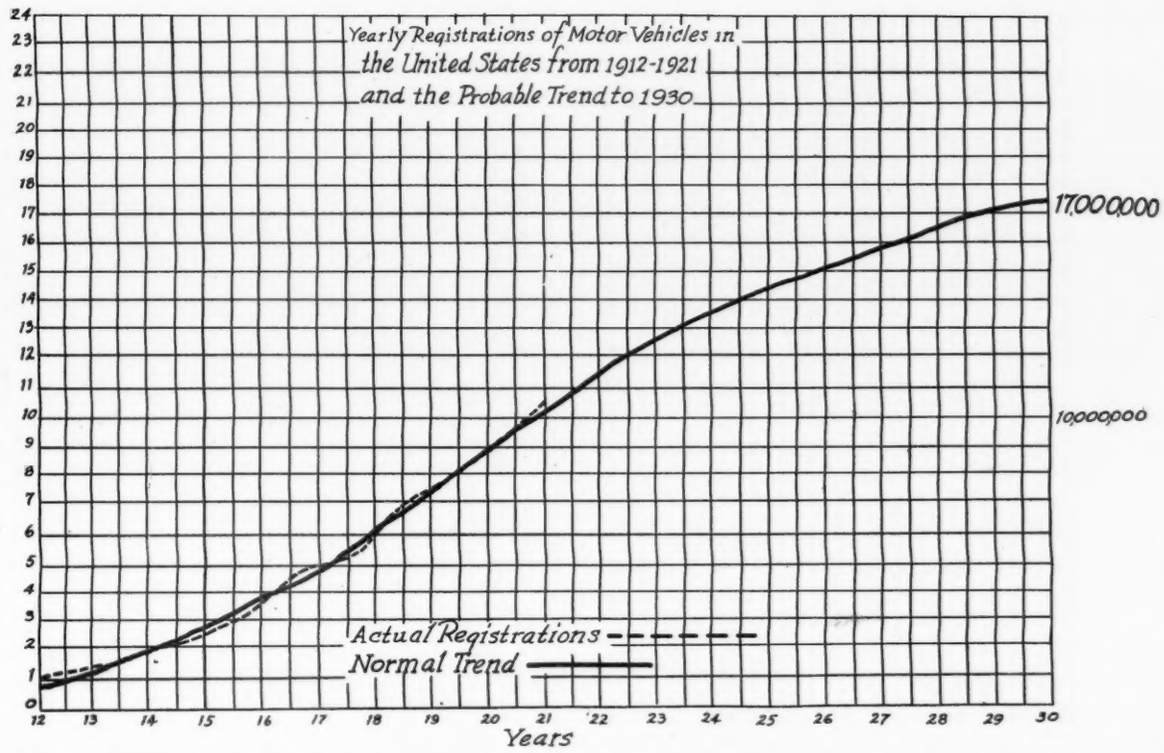
MOTOR AGE


Yearly Registrations of Motor Vehicles in the United States from 1912-1921 and the Probable Trend to 1930
17,000,000
10,000,000
Actual Registrations
Normal Trend
Years

Above is printed the actual automotive vehicle registration curve from 1912 to 1921. This curve is extended into the probability registration curve until 1930. The extension, plotted and copyrighted by R. D. Prescott, is prepared by the most approved mathematical methods. It indicates that 17,000,000 motor vehicles will be registered by 1930

The Future of Automotive Maintenance

Increased Registration and Use of Vehicles Insures That This Branch of Industry Will Move on in Financial Importace, Craftsmanship and in Popular Opinion

By CLYDE JENNINGS

THE future of the automobile maintenance industry is and will be entirely dependent upon the distribution and use of automotive vehicles. These vehicles should include all internal combustion engine vehicles—the motorcycle, passenger car, truck, tractor and in many cases the motor boat. It is possible, but not immediately probable, that the steam highway vehicle may enter into this list.

It is somewhat difficult to get accurate statistics as to the exact numbers employed in the automotive maintenance industry, just as it is always difficult to obtain exact statistics of any industry. This is especially true of the maintenance industry because there are so many small units and because some units that are engaged in other than in exclusive maintenance work. The latter is especially true of established machine shops which have taken on considerable lines of machine work for the smaller maintenance shops.

However the figures two years ago were such that it was convincing that the maintenance industry had outgrown the automotive manufacturing end of the industry. The development

of these figures is somewhat tedious and only the result is important. In a recent address before the Motor Accessory Manufacturers' Assn., Alfred Reeves, general manager of the National Automobile Chamber of Commerce, said that 200,000 persons were employed in the manufacture of automotive vehicles and 200,000 in the manufacture of accessories. When it is considered that there are in the neighborhood of 80,000 shops devoted chiefly to maintenance, the result is obvious. Maintenance has outgrown the combined vehicles and accessory manufacturing interests.

It is a possible development of the immediate future that the farm implement may become an important factor in the automotive maintenance industry. It is more and more evident to the students of the automotive industry that each day sees a closer connection between the automotive dealer and the farm implement dealer in the smaller city and a still closer connection is being noticed in the maintenance phase of both industries.

For a period there was the belief that the automotive mechanic or shop could not handle the tractor, but that belief is being dispelled in the shops of the small city dealer, where the man who works chiefly on cars and trucks has been the man to save the day by the adjustment of the electrical or fuel system of the tractor.

There was a time when this man knew the electrical or fuel system of a particular car, but many of these men are students and they are coming to know more and more the electrical system of automotive vehicles. This has been brought about largely by the tourist, as today any maintenance station is likely to meet with many makes of cars and the mechanic who properly serves his employer must be able to serve these vehicles as they come, regardless of make of car or make of system.

The car tourist was a pioneer in spreading the necessity for this fundamental knowledge on the part of the mechanical man, it was a short step from the car to the long distance hauling truck, and still a shorter step from the truck to the tractor, as many trucks and tractors have the same power plant.

This knowledge, it has been found lately, is fundamentally just as applicable to the motorcycle. So it happens that the motorcycle tourist is depending more and more upon the automotive shop for his maintenance. Also this knowledge has caused many automotive merchants to take up the motorcycle as an article of merchandise.

In fact, this concentration of service is leading to wider dealer lines with the progressive merchants, especially in the agricultural communities, until today the transportation merchant is becoming more or less familiar, as the dealers and manufacturers realize that it requires a very popular car to support an exclusive merchant in the small city.

The farm implements come into this conception of maintenance because the transportation merchant and maintenance dealer of the smaller city is building for himself the best machine and general metal working shop in the community and it is only natural that this man shall be called upon to stop the waste when the harvester or threshing machine is stopped in the field by a broken gear wheel or a broken axle. It has been found that an automotive welding outfit, lathe or drill press will repair the parts of a farm implement just as well as the parts of a motor car.

It is service that the farmer wants and he does not relish that his harvester shall be idle with ripe grain fields waiting, just because an implement dealer must telegraph to a distant city for that particular part. A welded part will do him just as well, and so this work is drifting to the man who has the equipment.

While the implement dealers are waiting for the farmer to come and buy their merchandise, the automotive type of dealer is "Asking 'Em to Buy" and, as a result, is forced to build a shop that is adequate to service his vehicles. In building this shop, he creates an asset for the entire community. It is only natural that when the farmer buys an implement of the automobile dealer that he will demand as good service on that implement as he gets on his car, he did not demand that of the old dealer.

This trend is more notable in the small city than in the larger community where the industry appears to building a system of specialty shops that may or may not be a permanent trend. Today there are cylinder renewing plants which are equipped with a special machine for regrinding or reboring and which also specialize in proper fitting of pistons and parts. There is being developed also the machine shop which specializes in automotive work, which turns out promptly and intelligently the part required for the orphan car. A shop which can weld or machine parts to meet the conditions required, which service is often required on current cars because of the complexity of the parts situation.

There is growing evidence that the car owners of the country do not believe the economic waste in the discard or junking of motor vehicles in the past is entirely justified. The great car owning public, and some who are ambitious to own cars but cannot afford to buy a new car of the type they want for special reasons, believe that there should be a stable value to a car that is only three years old and which has been run from 15,000 to 30,000 miles.

In this belief the car owners are entirely right and unless the automotive industry takes heed of this belief, there is grief ahead for some one. The used car, in the larger meaning, is of entirely too great a value to be thrown in the junk heap. Of course there is an increasing number of cars that must go to the junk heap annually, but too many have gone before there was real need and the public is beginning to regard this as an appalling waste and this same public is looking for some standard of education and craftsmanship in the maintenance departments that will be capable of intelligently judging the used car to decide whether it shall be renewed, just fixed or sent to the junk pile.

As this standard of education or judgment is developed, it must be and will be accompanied by a business development with which to repair these cars to a usable standard. In the past too many such enterprises have failed because a used car was only a used car and they were all turned into the renewing shop and overhauled without an intelligent diagnosis as to how much overhauling was required, how much would be justified by the future life of other parts of the car.

It is absurd to put a $300 overhaul job on a popular priced car if the body of that car looks like $400 to the consumer after this $300 work has been done. It is silly for a used car dealer to send a six cylinder block to a regrinder and spend the $55 on this particular part of the car if the axle is noisy and the body paint and upholstery will not be satisfactory to the man who wants to buy this car at the low price that must be made to dispose of it.

In other words there must be the appearance in this car that will justify a price to the consumer that will cover the original cost of the car and the work put on it. A $500 chassis with a $50 body is likely to be worth only $50 to the consumer.

When this idea is developed to the point where it will be within the next few years, it is going to mean a considerable development of the maintenance industry, or it will mean that this country will be dotted with paint, trim and enamel shops just as it is today with chassis shops, but in smaller numbers of course.

Today there is a decided tendency of automotive dealers in the smaller cities to finance a body renewal plant so that they may, to a degree, protect their investment in chassis work and give to the buyer of a new automobile a reasonable assurance that his car, after some use, will have a market value because the maintenance facilities of the community are as well prepared to socialize the used car to the degree that more transportation can be put into the used chassis.

All of these points are indicating a bigger and better future for automotive maintenance. They indicate an industry that will be better equipped to really maintain cars outside, as well as in the hidden parts. This complete maintenance of the car is carried to rather a high degree in the larger cities but is not well done in the smaller cities.

There is still much to be desired in the matter of education of the public and many dealers in what constitutes a renewal of the body, but that is gradually being accomplished. The vacant store room paint shop is making way for the regularly equipped paint shop, just as the regular maintenance shop is growing much more rapidly than the "alley shop" that formerly garnered a good deal of the maintenance.

There can be no question that the automobile owner is rapidly learning that maintenance is a dignified and honest craftsman-

ship and that he is learning to stick closer to the honest, maintenance dealer than ever before.

One big reason for this development is that more and more the new car dealer is taking his maintenance problems seriously and is learning that as more and more cars of his make are running in the community, so more and more the new car sales are made through the back door. The day of the new car dealer who believes that he has merely a job of selling something for money and no responsibility to the buyer of his merchandise is rapidly passing. Most dealers who have this idea are going broke and others cannot find cars to sell, because the factories are demanding a higher maintenance pledge as the days go by.

The counter argument is sometimes presented that the engineers and manufacturers are making better and more stable cars than previously and that the need of maintenance will be checked by these methods. This is entirely true but there is the offset against this of the extension of good roads, of the growth of the motor car tourist inclination and of the longer distances traveled daily by thousands of motor vehicles.

It is entirely true that the car of today requires less maintenance per mile than the car of yesterday but it is just as true that the car of today is driven so much farther than the car of yesterday and that the maintenance will to a degree average.

Today only seven per cent of the highways are improved in the broad meaning of that term. Road improvement is going forward as fast as the engineers and well equipped road building organizations can be developed and this is going to extend the mileage of the various vehicles to a point that will offset the improved work of the manufacturers and designers.

View the situation as you may, there is but one answer which is that automotive maintenance must continue to develope rapidly, not only as to numbers employed, but as to financial stability, craftsmanship, and respectability, of the individual establishments and in every way that will bring this biggest branch of one of the biggest industries in the country to the place to which it is entitled for the work that it accomplishes.

It is a decided mistake to view the automotive maintenance industry as merely a repairman's job. This industry must do the work that enables almost six times as many passengers to ride twice as many miles as the railroad vehicles that are maintained by the railroad shop crafts. Had you ever stopped to look at it in just that way? The figures for 1921, as supplied by the National Automobile Chamber of Commerce on this point are:

Passengers Carried—	
Motor Cars	6,990,862,000
Railroads	1,034,315,000
Passenger Mileage—	
Motor Cars	70,820,000,000
Railroads	37,329,114,000
Tonnage Carried—	
Motor Trucks	1,430,000,000
Railroads	1,642,251,000
Ton Mileage—	
Motor Trucks	6,479,200,0000
Railroads	306,755,332,000

Last June when the railroad shopmen entered upon their strike there was great consternation throughout the country and no one spoke of the railway maintenance as being a separate thing, but it was regarded as an important and integral part of the great railway industry. This is because the railway shopmen do not directly charge the public for the work performed. Their charges are made to the public indirectly through the charges for transportation. Automotive maintenance is sold to the public directly and so is not regarded as a whole.

This brings about a different attitude and the automotive maintenance industry suffers by the comparison in public mind, while industrially it is a larger, better paid and possess a higher degree of craftsmanship than the railroad department. The walkout of the automotive maintenance men today would be a great calamity because during the last ten years the business social development of both the urban and rural communities has been built around the automotive vehicle.

Then, too, the public has not the adequate conception of the maintenance establishment. The vehicle driver is quite familiar with the small shop, contained in one room and perhaps entirely visible from the entrance where the vehicle owners leaves his car. But few drivers are able to grasp the signficance of the larger shop and, indeed, few vehicle owners ever see one of the larger shops. In every large city there are some magnificent establishments devoted to automotive maintenance. Some of these are the maintenance departments of the dealers and distributors and are built for servicing one make of car only. Others are built for and by owners of large numbers of vehicles from the lightest roadster for sales purposes, to the heaviest truck that is permitted on the streets.

It would be a matter of great education to the public if more display was made of these maintenance establishments. The dealer who has 3000 cars running in his community and a maintenance department sufficient to handle the work on these cars, should make it a point to take every new car purchaser through this shop. The same is true of dealers who have a smaller number of cars running and who have adequately equipped and clean shops.

As a matter of fact, the size of the shop is not as important as the workmanlike appearance of the department. If the maintenance dealers of today who have decent, workmanlike shops would take the trouble to exhibit these shops to the public, they could quickly ring the bell on the disgracefully dirty, confused "gyp" shop. The public will quickly come to believe that honesty and thrift cannot thrive in filth and disorder.

Now if every maintenance man will rally for the good of the industry and make it a point to educate all of his customers to decency, dignity and craftsmanship the next year will be one of wonderful advance.

As an example of just what this maintenance industry can show for itself, it might be well to quote from the 1919 Census Bureau returns of the manufacturing census. In this respect the number of automotive maintenance shops was given at 15,486 with a value of products of $2,387,833,000. This compares with 3273 shops in 1914 with products valued at $503,230,-000. These figures do not appear especially imposing until one reads the definition of a shop listed in this class by the Bureau. The definition follows:

"The census of manufactures includes automobile shops only when they use power-driven machinery and partake of the nature of a machine shop. An establishment storing, washing and making minor repairs on a car is not included. The shop must be so equipped as to be capable of manufacturing new parts if necessary or it does not come within the scope of the manufacturing census, which is confined to factories. If a concern stores and sells cars and also maintains a repair department of sufficient importance to come within the census, a segregated report is required and only the statistics for the repair department are included."

All concerned with the automotive maintenance will admit that this is a pretty severe definition of a maintenance shop. The rate of increase from 1919 to date will be a sharper curve than that of 1914 to 1919, chiefly because of the greater appreciation of the duty before them by the men who are investing the money in these establishments and the gradual elimination of the tinkerer from this industry.

The future of the automotive industry is too great to be defined. It might be predicted, but that prediction would probably fall as short as most of the predictions recorded for the future of the manufacturing industry, so we will not attempt to predict. The fact that engineers are going to design better cars and the manufacturer is going to make better cars is no bogey. Neither the engineers nor the manufacturers can overcome the natural wear and tear of the greater transportation that is going to be exacted from the motor vehicle as the highway development takes place.

Nor will the engineers and manufacturers be able to forestall the work of the careless human being who will operate these machines. The day of the entirely fool proof machine is not in sight and until the wear proof and fool proof motor vehicle is built, there will be maintenance work.

In the old days, the blacksmith was the maintenance man for all transportation. He was a man much respected, not only for his craftsmanship and honesty, but as a rugged individual and a good citizen. The poets sang his praise and all respected him. The transportation maintenance man of the future is going to be the automotive mechanic and in the course of time he will be the subject of praise instead of comic strips.

Let us all work to this day.

National Pocketbook Is Open for Automotive Buying

Upward Trend of Business Indicates That Barring Unexpected Setbacks the Next Year Will Be the Best in History for Motor Vehicles

By SAM J. SHELTON

NOW is a good time for every man in the automotive industry—dealer, distributor, manufacturer, salesman, service manager, garage owner, maintenance shop proprietor—to occupy himself intensively with a business analysis of the territory in which he operates in order that he may prognosticate more or less expertly and thus be prepared in the months that follow to harvest the maximum return of which an intelligently cultivated field is possible.

It is time to look around and observe the fertile and the fallow areas, the prosperous and the less fruitful elements of the populations which constitute the automotive merchant's sphere of activity. The cultivation then may be done where the opportunities for productive results are greatest and the waste of effort will be reduced to the minimum. In the final analysis this is a question which, although closely related to the economic conditions throughout the United States and the world, can be definitely answered only by the individual who knows intimately the people among whom are his prospective customers and patrons, and who alone can control the effort that he is willing to put forth to make business better.

The automotive merchant primarily is concerned with a comparatively small field—that community in which as a retailer he disposes of his wares to the consumer. If the automotive merchant is more than a retailer—if he is a distributor, jobber, or part of a manufacturer's sales staff—his field is enlarged accordingly and then the sum of business as it is found in all the various retailing communities within the area of his interest is the index of his prosperity.

Local Conditions Affect Business

But it is a fact that in the modern business structure no community can live unto itself. Commerce has extended its lines until the general tendencies of business upward or downward apply with more or less equality of degree throughout the country. One who wishes to profit, however, by a study of present business conditions as they are likely to affect the future must not lose sight of the fact that local conditions are capable of greatly modifying the prevailing trend, even to the point of a bright and prosperous spot within an area of gloom, or on the other hand a section of dark depression where all around is life and energy and profitable progress. Physical manifestations of climate, soil and insect pests, as affecting agricultural productivity, are largely responsible for these variations.

If the phenomenal automotive business of this year is to be looked upon in the nature of a freak, something not likely to continue, then the industry has not profited but has suffered a loss. The stability of the industry, its place in the economic life of the nation, requires a continuance of business on a level which one who studies the present indications foresees as higher than that of this unusual year.

This means that this winter, next spring, next summer and into the fall again, the automotive merchants of the United States will sell more cars, trucks and tractors, more gasoline and oil, more equipment and accessories and more maintenance service than ever before. There may be individual communities where this will not be possible, due entirely to local conditions, but on the whole the indications that are apparent in business progress today point to the complete realization of this happy condition. Only unforeseen developments can prevent it.

Record Production This Year

Analysis of the indications which point so auspiciously to the future must begin with the farms of America, but first let us see what the automotive industry has accomplished this year as compared with other years.

There were produced in the first nine months of this year a total of 1,867,945 cars and trucks. This is within 337,000 of the total production for the year of 1920, the largest year the industry has ever had. An average output of only slightly more than 110,000 cars and trucks a month for the last three months of this year will bring the total above the 2,205,000 of 1920. It can no longer be doubted that this will be accomplished, for with the single exception of January, when recovery from the period of depression had not yet set in, there has not been so low a production in any month of this year.

As compared with 1921, this year's record is far ahead. In the first nine months of last year there were produced 1,238,426 vehicles, 629,519 fewer than in the corresponding period of this year. A further significant fact is this: In five consecutive months this year—May, June, July, August, September—the production established a new record for these respective months. Although figures for October production are not available as this is written, there are indications that the total will be very near the September figure.

The experience of the automotive industry this year effectively removes from discussion of the immediate future the question of saturation. With more than 10,000,000 cars and trucks in operation at the beginning of the year, there will have been placed into the hands of new owners, by the end of this year, more than 2,000,000 new vehicles. Taking the frequently accepted estimate of five years as the period of useful life of a motor vehicle, there would be an annual scrapping now of nearly 2,000,000 vehicles and within a few years of more than that number, so that it would take a production each year equal to that of this year to maintain at the present level the number of vehicles in operation.

It cannot be doubted, however, that the number of vehicles in operation is bound to increase considerably over the 10,000,000 figure. Without going into further discussion along this line it is easily apparent that there is no reason for any automotive merchant to be afraid that his business will be suddenly wiped out because there is no longer a market for his wares. The market is there, the desire for motor car ownership is becoming well nigh universal among the American people and sales and maintenance in the next few years will be limited only by the ability of the people to pay.

When the business depression of 1920 came with devastating effect upon American business, the automotive industry was among the last to feel its effect. But the automotive industry was by no means exempt. It suffered in time probably as keenly as any other great business. Throughout the year 1921, although in that year it was responsible for a truly remarkable volume of business, it felt the effects of a nation-wide depression.

Industry's Quick Recovery

At the first sign of the return of prosperity, early in 1922, the automotive industry became active and within a few months it had jumped to record-breaking proportions despite the fact that the two branches most dependent upon the activity of other business—trucks and tractors—remained in the shadow of depression.

The national conscience is, therefore, attuned to the whirr of the gasoline engine and the national pocketbook is open for individual highway transportation when closed to many other worthy claims. How deep and wide and well

filled is that pocketbook for the year that lies ahead?

Consider the farmer. Nationally speaking, the wheat crop is 810,000,000 bushels. The price is well over $1 a bushel. The farmer is not satisfied with that price. He says, and rightly, that it is not commensurate with the wages he has to pay for help and the prices exacted of him for most of the commodities he uses. But he must admit the automobile manufacturers have been fair to him. Never before would his dollar buy so much motor car value as today. He keenly perceives this fact and it gives him a friendly feeling toward the automotive industry. It is a big factor in determining him to spend a part of his first surplus cash for an automobile and the necessary upkeep. But wheat is not helping him greatly to accumulate a surplus. Nor is corn, except as at the prevailing price of around 65 cents it goes to produce nine- and ten-dollar hogs.

The corn crop is large, although slightly less than that of last year, and by spring it will have added millions of dollars to wealth of American farmers via the route of the porker. There is a good deal of wheat being held on the farms, sometimes from choice and again of necessity because of railway transportation deficiencies. Fortunately, bankers are in a better position than last year to finance such deferred marketing and by wisely doing so they will add many dollars to the farmer's profit when he sells at a higher price that is to come. Europe's crops have been short this year and it is practically certain that there will be a good export demand for grain.

Cotton Rules in South

Cotton is truly king in the south this year. The estimated crop of 10,135,000 bales is 36 per cent greater than last year's crop and the price of around 24 cents a pound is more than twice that of any of the late pre-war years. Just lately reports are coming from the south of unusually good business by automotive merchants.

The present and prospective prosperity of farmers is undoubtedly to be the greatest factor in automotive sales in the next year or two. Despite the record-breaking sales of this year, the farmer has been a poor customer. The cities and towns have absorbed the great bulk of the cars and practically all the trucks. They even took a good many tractors for industrial uses. What the farmer has earned this year has largely gone to liquidate debts at the banks and elsewhere. After the year has largely gone to liquidate part of his debts at the banks and elsewhere. What is left will preesntly be taken care of and next year, if there is anything like a normal crop and prices are fairly good, there will be some liberal although discriminate spending.

On Jan. 1, 1920, there were 6,448,366 farms in the United States. If anybody needs one or more motor vehicles it is the farmer. It is a small farm, indeed, that could not make a truck a paying investment and a passenger car for the family is coming to be considered almost tempted by the wonderful values at today's prices.

Good roads are another factor. Hunas much of a necessity as the telephone and rural free delivery. There are still many farms without any sort of automobile. There are others with cars that have outlived their usefulness but which have not been replaced because of lack of money. Now that things are picking up, many an old car is going to the scrap heap to make way for a new and more useful vehicle, and the farmer who has not heretofore seen his way clear to invest in motor transportation is being

Here in brief are the outstanding facts, elaborated upon in the accompanying article, upon the basis of which it appears that in the next 12 months the automotive industry is likely to enjoy the most flourishing period of its history:

1. Farm prosperity is returning.

2. Business in general appears to be entering a flourishing era.

3. There is abundant room for more motor vehicles.

4. Motor car value at present prices is greatest in the history of the industry.

5. Hundreds of millions of dollars are being expended in construction of permanent roads.

6. Business is making greater use of automobile passenger and commodity transportation.

dreds of millions of dollars are being expended by Federal, state and county governments in the construction of permanent highways which make possible and desirable in greater degree than ever before passenger and commodity transportation by motor vehicle. And most of these roads reach right out to the farms.

Improvement of business conditions generally means much to the automotive industry. In spite of strikes and downward movement of wages throughout the summer automobile sales mounted steadily. With the coming of fall there has been marked improvement in the business situation. Wages have stopped going down and are even showing an upward tendency in some industries. Unemployment is no longer an acute problem and there are no great nation-wide strikes throttling and threatening the business of the nation. Gradual increase in the price of many commodities is noted. It is entirely possible that the winter will see some increase in unemployment, depending a good deal upon the severity of the weather. But from all indications such idleness will be only temporary and by early spring industrial activity will approach a new level.

Business is increasingly making use of the motor vehicle as an instrumentality of its progress. One manufacturer who recently analyzed his sales for the current year found that 27 per cent of the passenger cars sold by the company were for strictly business uses. Salesmen are using automobiles widely for calling on their trade both in the city and in the country. Many large corporations maintain passenger automobiles for the transportation of their executives upon company business.

The increased family incomes in the cities incident to good business encourage the purchase of automobiles, and the ownership and use of a car, by bringing family contentment and widening social and business intercourse, often results in greater efficiency and therefore larger incomes for the working members of the family.

A Chance for Trucks

The truck deserves a word for itself. Approximately 10 per cent of the motor vehicles manufactured this year have been trucks, but on the whole the truck phase of the automotive industry has not been considered to be flournishing.

In last August 24,000 trucks were produced and in September the number was nearly 19,000. These vehicles are money earners and now that industries are watching their pennies there must be a distinct and profitable use for each one before it is purchased. The optimistic note for the future of this branch of the industry is in the reviving life of business in general. A small per capita increase in the consumption of commodities in the next year will add a tremendous volume to industrial transportation with which the railroads at this time are taxed to capacity. Here again good roads are to help the automotive industry and unless all signs fail there will be many trucks sold in the next 12 months. But they must be good trucks.

The tractor, having suffered threatened oblivion in the last two years (but not so much so as some reports have indicated), is already becoming the object of renewed attention. Its future is with the farmer and now that he is on the way back he may be expected to wisely and deliberately pick out what automotive power he actually needs to conduct his farming operations most profitably.

More Money for Maintenance

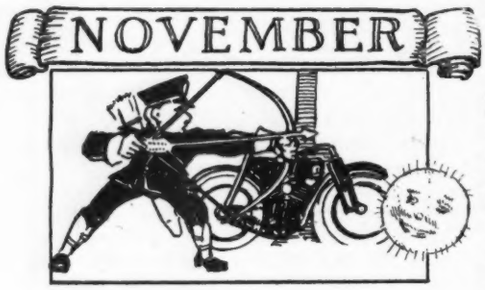
Increased sale of supplies, equipment, accessories and maintenance service goes hand in hand with the greater sale and wider use of motor vehicles. It follows that if business is good and cars and trucks and tractors are sold and used extensively, there will accordingly be money spent for operation and maintenance. This phase of the industry has profited handsomely this summer and now with the coming of winter the wide-awake merchants are benefiting by the increasing tendency toward the all-winter operation of cars.

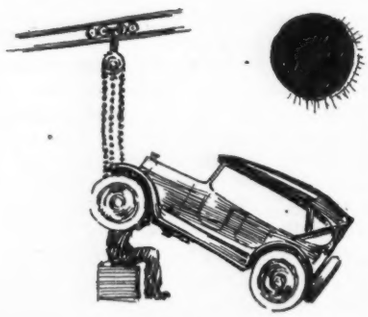
Undeniably business prospects are bright considering the country as a whole. The automotive industry, with the start it has made this year and the moral prestige of low prices and high values, is in an unexcelled position to take full advantage of whatever prosperity that comes. The individual automotive merchant, knowing the national trend of business, has only to analyze his own local conditions, measure them by the country-wide tendency and multiply by personal effort to judge with fair degree of accuracy the immediate future that lies before him.

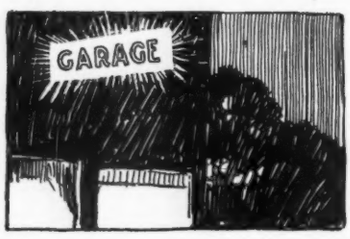
An Almanac for Automotive Dealers

Something to Think About Every Day This Winter

By TOM WILDER







1—Clear away the Hallowe'en window display and begin to think of something for Thanksgiving. Lay in stocks of hood and radiator covers, also heaters. If you have a class of trade that falls for it, a line of winter apparel will probably go well. Steamer rugs, fur gloves, caps and galoshes are among the approved items.

2—Look over the heating plant, see that grates are all in good shape for winter service, clean out flues and see that smoke pipes and chimneys are tight, pipes have a way of rusting out during the summer.

3—You should have a stock of alcohol so when the mercury drops you can cash in.

4—Saturday is a busy day with little time for special duties. If you have any time spend it with the farmers who are in town today. Sell them on winter overhauling of cars and tractors.

5—Go to church and after church, when your mind is in a receptive mood, go through the Winter Service Number of MOTOR AGE. You can't fail to cash in.

6—Make a sales drive on enclosed cars take the open ones in trade and fix them up for spring sales. Send periodic letters and make personal calls on all prospects.

7—Keep the radiator hydrometer handy so you can test solutions in cars that look suspicious. If near the danger point advise the owners and make a sale of alcohol.

8—Install that new accounting system now while work is light so it will be working smoothly when the spring rush comes.

9—Get the oil in a warm place so it can be handled more readily. It costs more to wait for cold oil to flow than you make on the sale.

10—The shop and garage should not be without some means of ventilation. Carbon monoxide is given off by badly functioning engines and is not only poisonous to inhale but mildly explosive as well. It is known by its pungent odor. It is the same gas that escapes from hard coal stoves when the wind blows down the chimney. Use your ingenuity now to correct this evil.

11—Prepare a diagnosis sheet and send to customers for them to try on their cars. In this way loose wheels and steering mechanism, leaky valves, noisy pushrods, faulty timing and carbureter performance can be called to their attention. When they come in for adjustments call their attention to more serious faults if there are any.

12—Spend the day with your family. You have slaved every Sunday all summer and deserve a rest. If you get restless plan that Thanksgiving window display. Get it in early—should be ready this week. Read MOTOR AGE. Keep abreast of the times.

13—In snow bound sections make a hard drive for Winter Overhauling. Try to sell all your customers on the value of having cars fixed up while the snow is on the ground.

14—Have your printer make up some cards containing a reproduction of the chart giving freezing temperatures of alcohol and water mixtures and send them to your customers with your next flyer.

15—If the shop was cold last winter, devise some means of closing it off from the garage so that its temperature may be kept higher than that of the garage.

16—Along with the winter overhauling, fix up some of the shop equipment that has gotten badly out of repair from hard usage.

17—Inspect the roof for leaks around the skylight where the snow will pile up and cause the water to run through when it melts. A coat of red lead and oil on the exposed metal work will prevent any further rusting and prolong its life.

18—Examine the garage doors to see if they cannot be made tighter. They are usually a source of cold drafts across the floor.

19—You should get a complete rest and change of scene, at least once a week. If you can't close up completely, take turns with the men tending shop. Take the family out into the country; a nice crisp afternoon ride will do you all good.

20—Perhaps you don't know it, but you can install an automatic sprinkler system in your garage and pay for it out of the saving on insurance. Think of the advantage you will have over your competitors if customers know their cars are absolutely safe while in your care. Ask your agent to find out about it or tell you how, today.

21—Have you a washrack? You can save lots of grief on repair jobs if the cars are washed. Refuse to work on cars that are loaded with mud and axle grease. Charge the washing to the owner. He'll get his money back in saving of time.

22—An overhead track with hoist is a great labor saving equipment. Saves much time, energy, and chance of damage in moving engines, rear axles and other heavy parts. It enables a man to raise one end of a car so he can work under it.

23—The electric sign is like a lighthouse to the benigned tourist coming into a strange town. It won't do any good now, but now is a good time to get figures and order it.

24—In every community there is some car, Ford excepted, which predominates. If it is a Runwell in your town, tool up to service that car and work out a flat rate system of charges. With special tools and labor-saving devices you can lower charges and make a reputation on this service.

25—Arrange a series of ads in the local paper, or, if there is none that reaches your trade, send them something through the mail periodically all winter, so they will know you are alive and at their service.

26—Sunday is a good day to spend with the family. They haven't seen much of you all summer. If you get restless, there is the Nov. 23 MOTOR AGE to peruse.

27—In the Northern states freeze-ups are due most anytime now. Get weather strips on the windows. See that the water pipes are well protected.

28—Keep the alcohol stock up and the hydrometer handy. Don't let your customers' radiators freeze or their batteries get too low.

29—Thanksgiving comes tomorrow and is always a big day in the country. If it is a nice day there will be lots of driving and someone will have to be on the job. Try to arrange so that all members of the force will have a fling at the turkey.

30—Punish the Great American Bird, also have a thought for the Pilgrim Fathers who founded the day. Haven't you more to be thankful for than they had?

1—Clear away the Thanksgiving display and begin to think about something classy for the holidays. Get accessory sales into the Christmas window idea.

2—Women are always stumped to find Christmas presents for husbands and brothers. Make a drive to sell them popular accessories or certificates which the men may later use to purchase what they want. Get this under way early.

3—Go to church again, whether you need it or not; once a month won't hurt anyone.

4—Plan a show window for accessories inside the service station, to create a desire in the service customer. If you illuminate it well it can be built into a dark corner, thus making the corner an asset.

5—Make another drive for winter service if work in the shop gets low.

6—Many show windows are built with the sills too high; they are often small and old fashioned. It will mean business to reconstruct these, making them up-to-date, with the sills not more than 18 inches above the sidewalk, so that the passer will not have to strain himself to get an eyeful. Make them broad, too; they are much more conducive to trade than blank brick walls.

7—When you install any new machines, make them individually motor driven. Pull away from the limiting scope of the lineshaft and belt. Start with a good electric drill.

8—A good heavy snow is due. Are you ready with equipment for clearing it away?

9—Send out another call on the Christmas present idea.

10—After dinner plan that Christmas window display—maybe the family will help either with the design or the execution. MOTOR AGE offers a few suggestions in this issue.

11—Mondays are always the clean-up days around the shop, even if summer traffic is light. Why not set all hands to cleaning up every Monday morning from 9 to 10? This idea has proven successful in big shops, try it out, you will be surprised.

12—Small dealers and service men complain that they have no time to read MOTOR AGE, but they are really kidding themselves. Start today to go through the paper systematically. Mark articles of interest to the different men in the organization and send it down the line so that all may be benefited. You don't know till you try how much good can be gotten out of it. Form the habit of going through it.

13—If the snow isn't too deep, make another effort to get in winter overhauling.

14—Oil barrels are the curse of the small garage. If tanks holding 60 to 80 gallons are installed the oil may be emptied as soon as it arrives and the barrels returned at once. The tanks should be large enough to hold a barrel when there is still considerable of the last barrel left.

15—If not already under way plan improvements in the layout of the whole organization so that changes may be made during January and February, while the men have time.

16—Watch the batteries of customers' cars. If they seem inclined to run down boost the charging rate of the generators so that they will keep up to the extra strain of the cold weather starting and lighting systems.

17—You may have to do a little work this Sunday if the Christmas accessory drive is working out as it should.

18—Remember that last week you inaugurated a clean-up hour from 9 to 10. Try it again this week and see if it doesn't work even better than before.

19—Take a few minutes and look over the front of your building to see if its appearance can be improved. There are probably a lot of advertising signs tacked and painted on it which never have done you any good. Perhaps you do not handle some of the lines advertised. Perhaps some other brands than those shown are more popular and your signs are driving trade away.

20—Why not plan a dinner at the hotel for all your employes. Make a little speech about the prospects for the coming year, your hopes and expectations. Jolly them a little about past service and bring out the necessity of pulling together instead of passing the buck to each other. Ask them for suggestions—you will get some.

21—Examine the roof to see that the drains are all open. If they are frozen a little salt will usually open them up.

22—Watch for open windows and other leaks where heat losses may occur.

23—You should be pretty well sold out on accessories if your "presents for their husbands" drive on the women has been a success. Prepare for a two-day holiday.

24—Help the children trim the Christmas tree.

25—Christmas Day is one day of the year when the family should be together. Cut business entirely.

26—Clear away the Christmas display and replace it with some neat but simple decorations appropriate to New Year's, which will be next.

27—Check over the accessory stock. See what is left after the Christmas havoc. If there are more of some items than the season warrants get them ready for the after inventory sale.

28—How about that new accounting system? You should have it now to start the year right. But the main idea is to get it going before spring.

29—Keep the snow cleared away; also the drains opened for that January thaw.

30—Get out the monthly statements.

31—Stop and make a list of the things you have "put off till tomorrow." You will find much food for thought in this list, on this the last day of 1922.

1—New Year's Day—Don't make a lot of idle resolutions that don't mean anything. A resolution to clean up and keep clean will do more good than anything, if the resolution is carried out.

2—Date your letters 1923. Take inventory of accessory and parts stock. An after inventory sale of shop worn and old stock may move all of it and a lot more besides.

3—A good habit to start forming the first few days of the year is that of tending to correspondence the first thing every morning.

4—Install a woman's restroom if you can spare the space. Furnish it fittingly, this issue of MOTOR AGE offers a few suggestions. Your wife can help you.

5—Overhaul the parts department. Make it more convenient for customers and mechanics. Work out a new and more systematic arrangement so that everything can be found easily.

6—Start rebuilding used cars to bring better prices, especially fix them up outwardly by new paint and trim. Watch for the New York show report in MOTOR AGE. There is sure to be something in it to interest you.

7—Your appearance in church again may cause a sensation but take a chance, better a pleasant sensation than something else. Once a month won't hurt you.

8—Get going full speed on those winter overhauling jobs. If you get them done and paid for, you may sell a paint or trim job or both.

9—Test radiator solutions of your customers when they come in and warn them if they need alcohol. These are the days when they must be careful.

10—January is the month of extreme cold. Watch the heating plant whether it be stove or steam boiler. Keep the ashes emptied and hauled away. Ashes packed under the grate will cause it to burn very easily when fires are being forced. A shut down for repairs is serious at this time.

11—Owners who have old cars and do their own work can be sold on cylinder grinding, new pistons and rings. You can send the grinding out and make a good commission without doing any work aside from handling the block.

12—Run a special sale of used cars marked down to reduce stock and keep business moving.

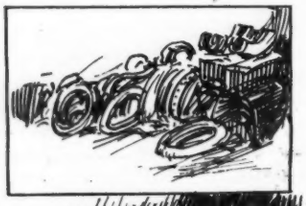
13—Turn slack spells from misfortune into opportunity by doing some of the clean up, machine repair and shop improvement jobs that you have had in mind. Build horses and other handy equipment to aid in shop operation.

14—These winter Sundays are the most valuable days of the year, as they enable you to get away from the grease and smoke of 10 months of garage existence.

15—Start some sort of system for compiling lists of prospects in view of the spring drive for car sales.

16—Suggest a little lighter oil added to transmission and rear axle. Heavy oil and transmission grease sometimes become so stiff in cold weather that they do not flow around the gears, allowing them to become dry and noisy.

17—It may be discreet in many cases to refrain from taking every kind of job that presents itself. This is the time of year to make trade agreements with spcialists in the lines you do not wish to handle. Get a paint shop, battery shop and electric shop on your list and boost for them so you can get service when the rush comes.



18—Install racks or lockers for special tools with hooks holding them so that if a tool is gone a tag will show who has it. Tools of this kind must be returned at once when the men have finished with them.

19—Clear away the snow.

20—Invite the farmers to come in Saturdays. If they get the habit of dropping in there may be a couple of tractor sales before spring.

21—It is best to banish business from your thoughts on Sunday but if you get restless there is always a thought or two in MOTOR AGE.

22—If your tire room is full of a lot of case vulcanizers and benches that haven't been used since tire prices took the big drop, move them out and use the space.

23—Keep going on those jobs of overhauling. This is the time you set aside for them so get them out of the way.

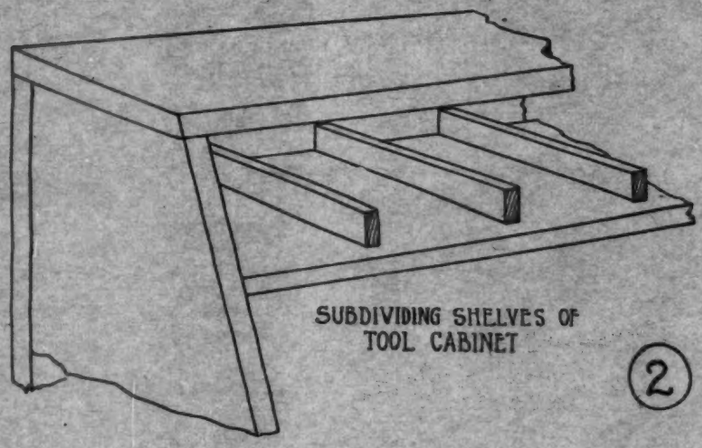
24—Work out some system of handling oil so that your man will not have to make a trip from the curb to the rear of the shop every time he sells a quart of oil. There is no profit in that. A neat rack for a number of quart bottles; convenient faucets where the oil under slight pressure can be drawn quickly, and pumps connected with underground tanks are three good ways, given in the order of their cost.

25—Change the accessory show window. Make a last display of Winter material. Next month at this time the season will be over for such sales.

26—Keep the stock of chains complete. These are the days when they are in demand.

LAYOUT AND EQUIPMENT OF

Showing the Location of Essential T
Also Plans for Making the Bench, Tool



SUBDIVIDING SHELVES OF TOOL CABINET

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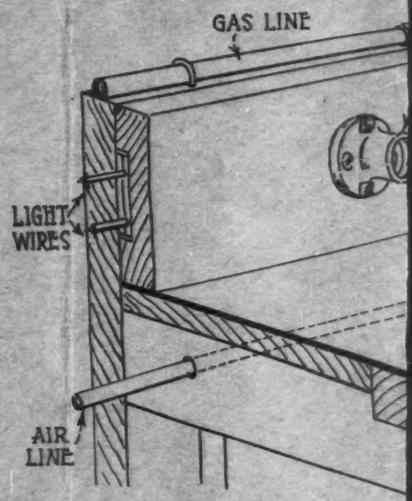

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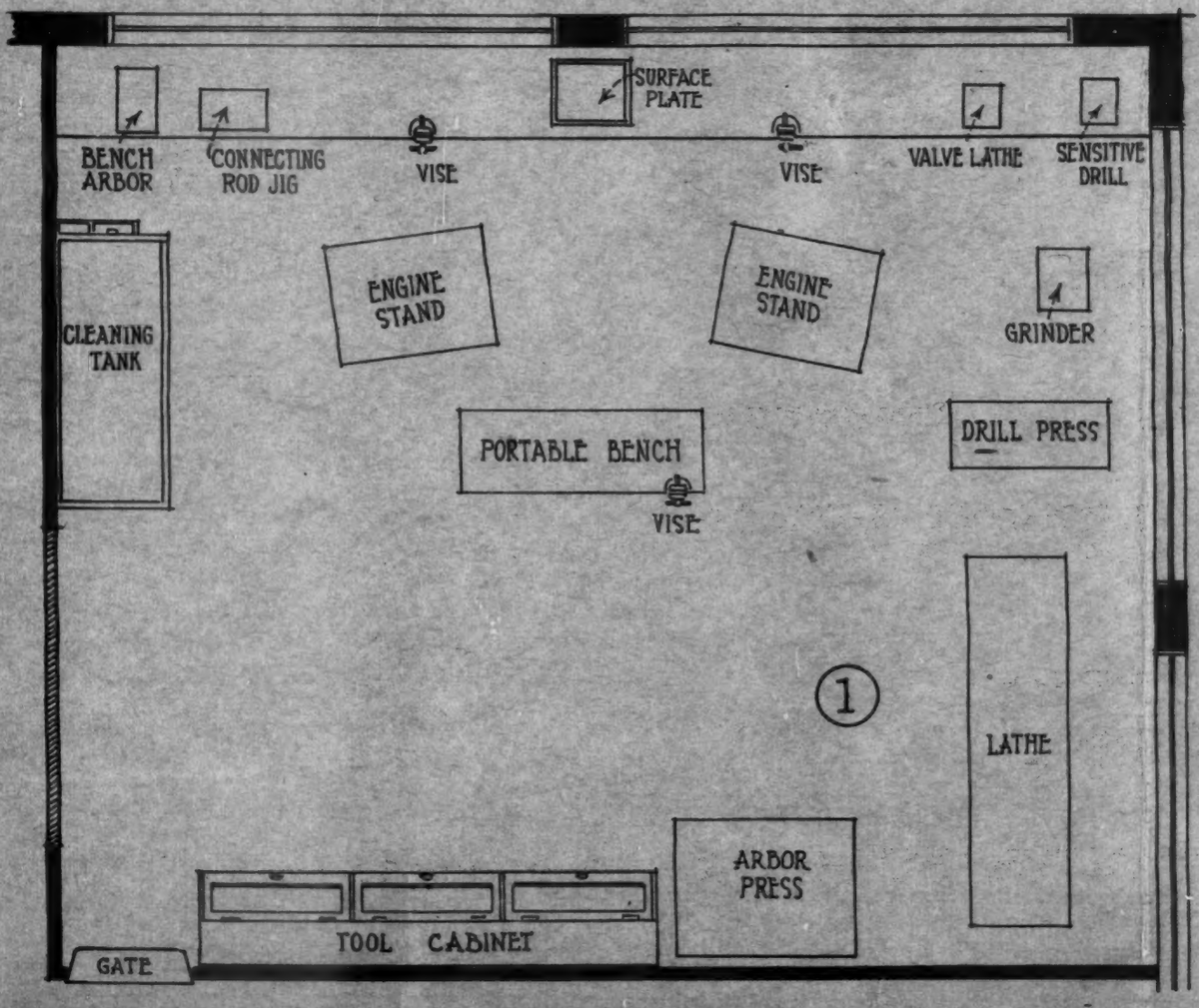

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Supplement to **MOTOR AGE** *Winter Service*

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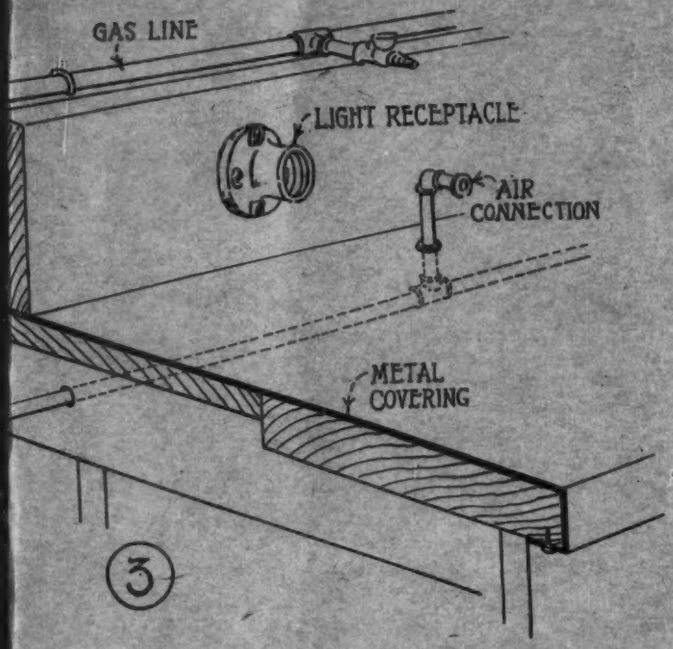

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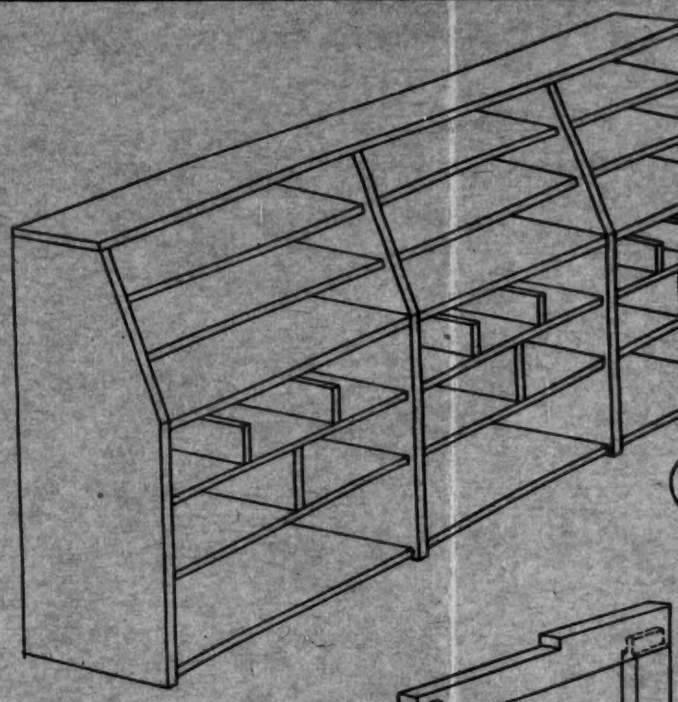

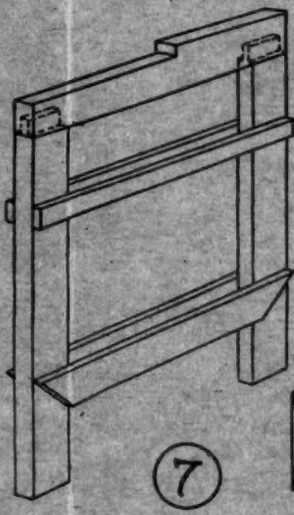

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Explanation of Diagrams

1—The plan view of the shop, approximately drawn to a scale of ¼ in. to the foot.

2—A detail of the manner in which the tool cabinet shelves can be divided to prevent tools becoming disarranged.

3—How the workbench is wired and gas and air brought to the bench top for the mechanic. The bench is covered with zinc.

4—A perspective view of the tool cabinet with the doors removed, giving a good idea of the shelving.

5—Dimensioned drawings of the tool cabinet. It should be divided into three sections for better classification of equipment.

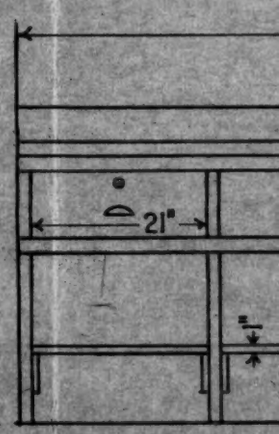
6—The cabinet with doors closed. Each door is fitted with a lock. The small tools are kept on the top shelves.

7—A close-up of the bench sections and drawer. The latter are all 22 in. wide, save the end ones which are 21 in.

8—Details of the bench. The illustration clearly shows the manner in which the bench is timbered.

9—End elevation of the bench. This shows the location of the drawer guides and shelf at bottom.

10—Side elevation of the bench. All sections are made of 2-in. material placed 24 in. center to center.



FOR AN AVERAGE MAINTENANCE

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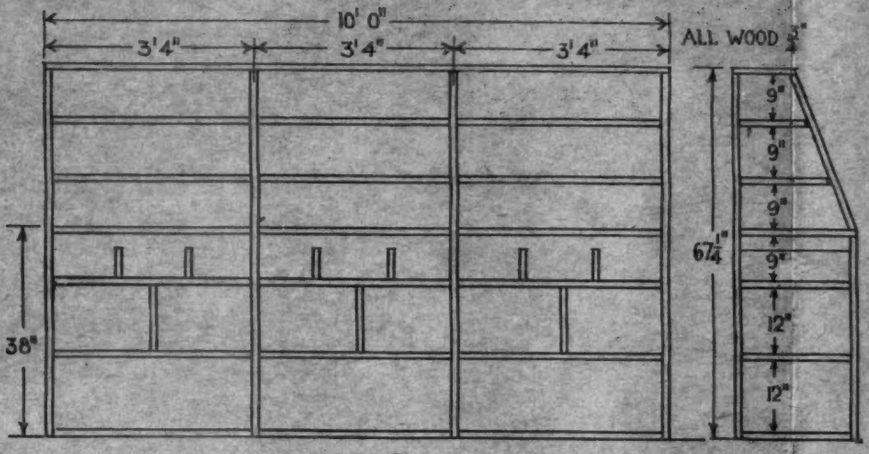

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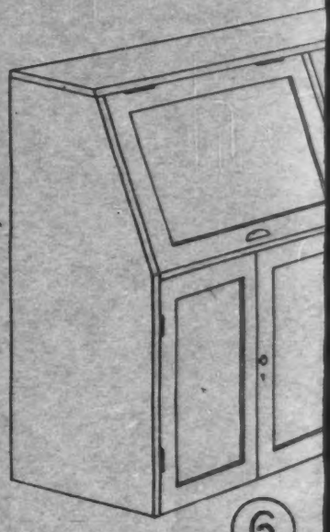

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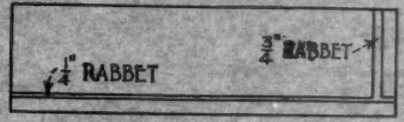

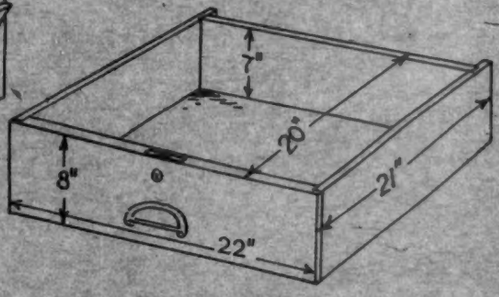

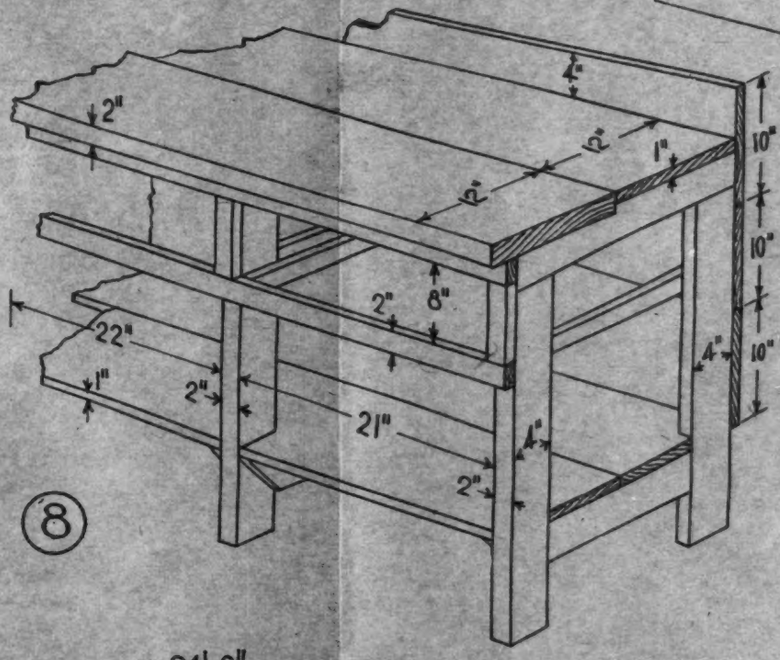

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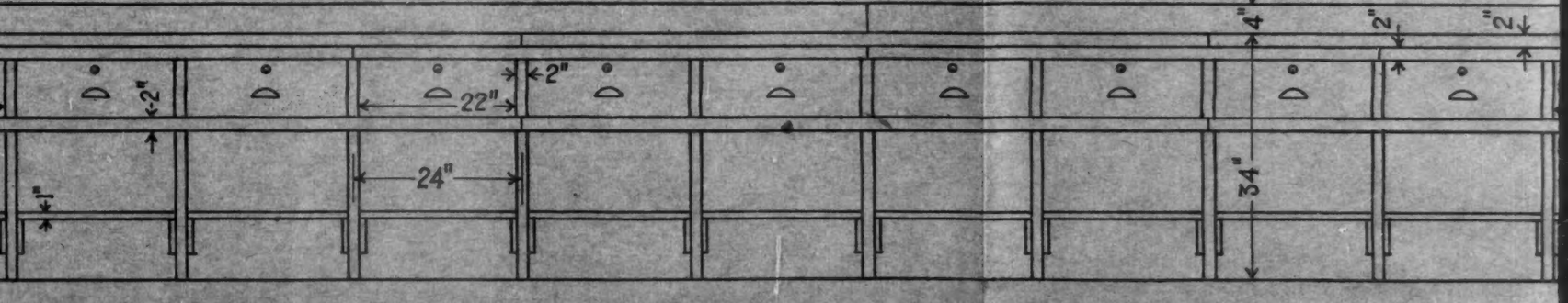
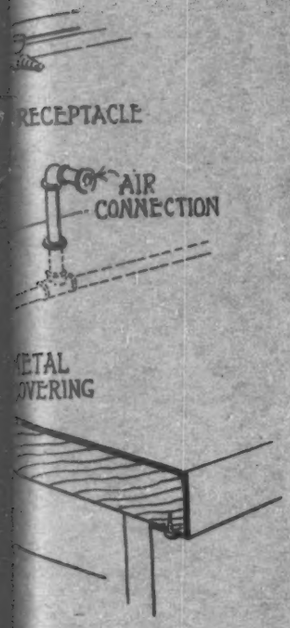
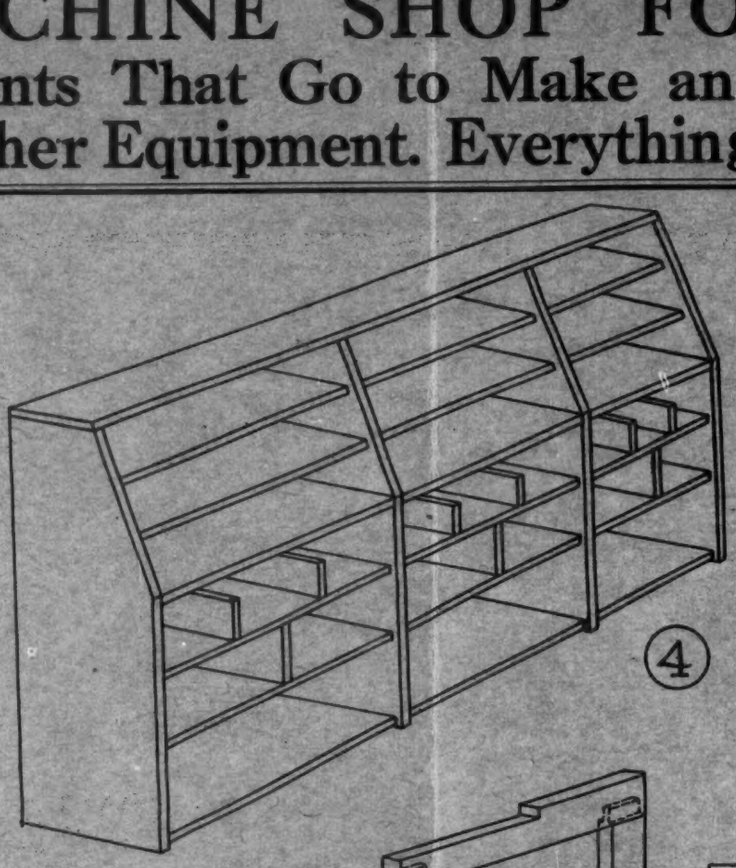


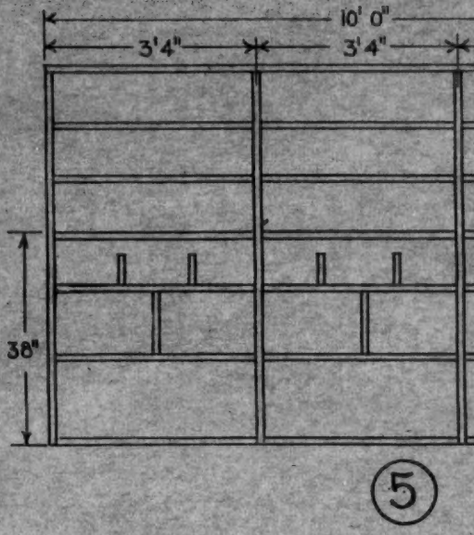
lement to MOTOR AGE Winter Service Number of November 2, 192

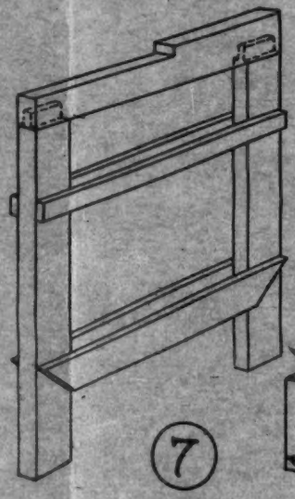
THE MACHINE SHOP FOR AN AVER

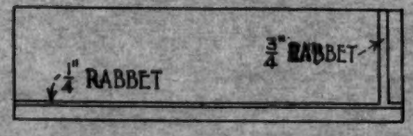
ls and Fitments That Go to Make an Efficient Shop for t
binet, and Other Equipment. Everything Has Been Worked C

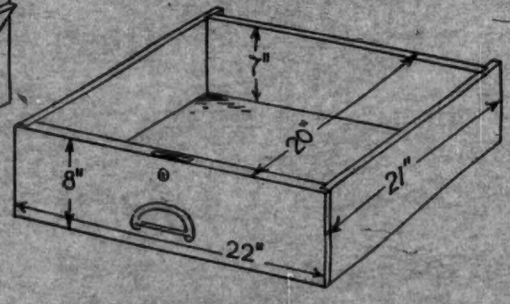












xplanation of Diagrams

the shop, approximately drawn to a scale of ¼ in.

nner in which the tool cabinet shelves can be divided coming disarranged.

ch is wired and gas and air brought to the bench top The bench is covered with zinc.

w of the tool cabinet with the doors removed, giving shelving.

wings of the tool cabinet. It should be divided into better classification of equipment.

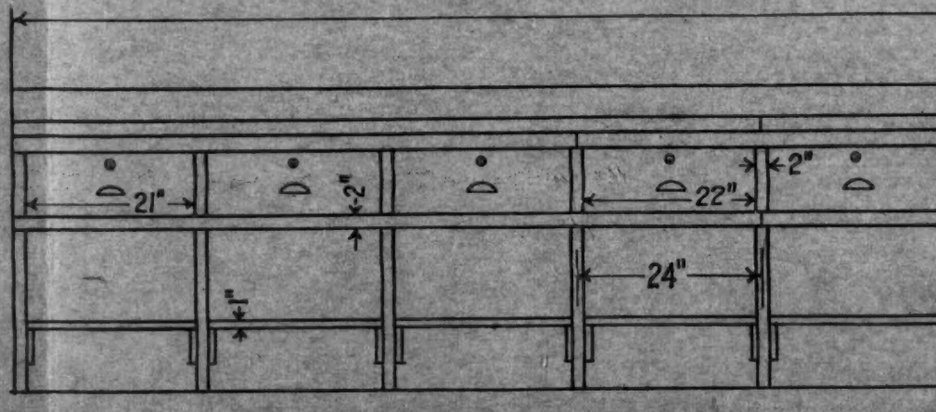
doors closed. Each door is fitted with a lock. The pt on the top shelves.

bench sections and drawer. The latter are all 22 in. d ones which are 21 in.

nch. The illustration clearly shows the manner in s timbered.

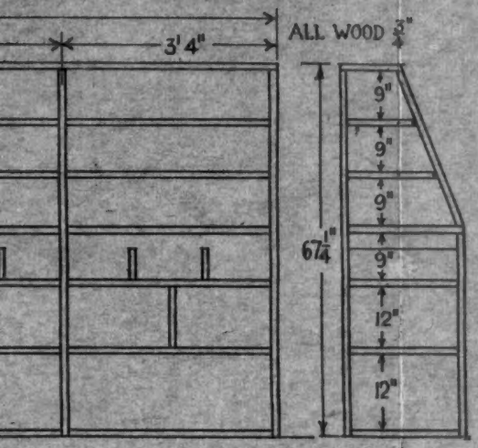
the bench. This shows the location of the drawer t bottom.

the bench. All sections are made of 2-in. material r to center.



RAGE MAINTENANCE STATION

or the Small Town Dealer Particularly
d Out to Scale to Save the Builder's Time



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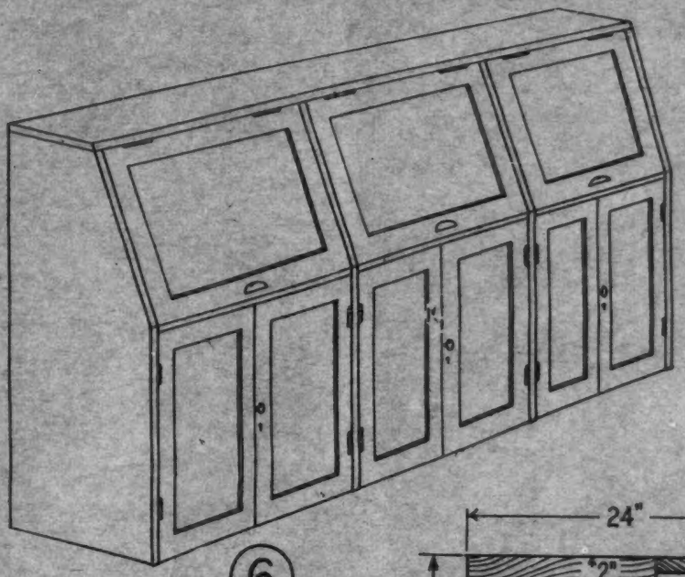

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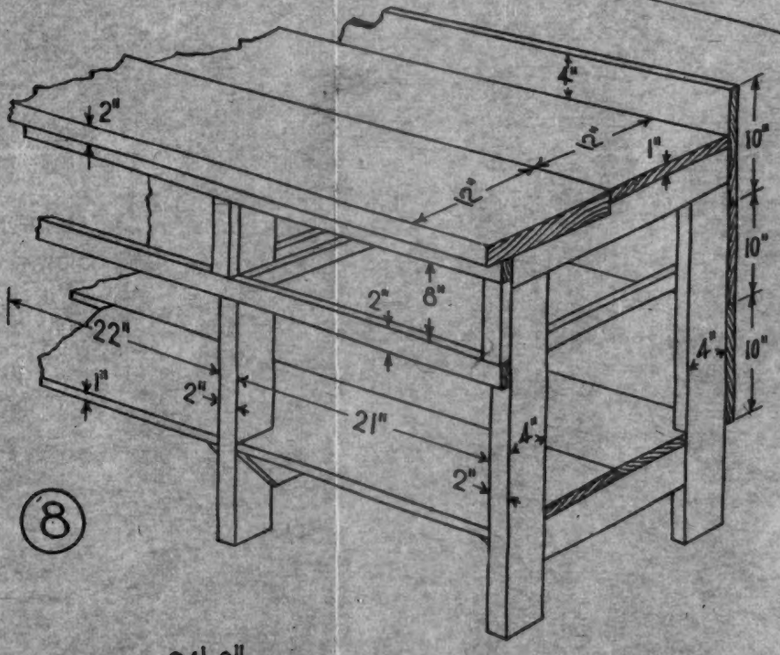

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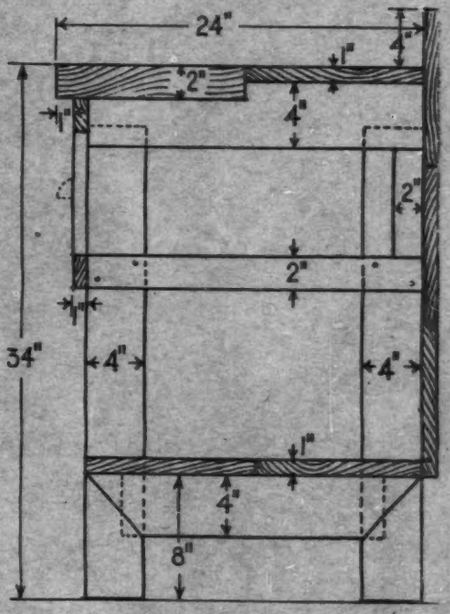

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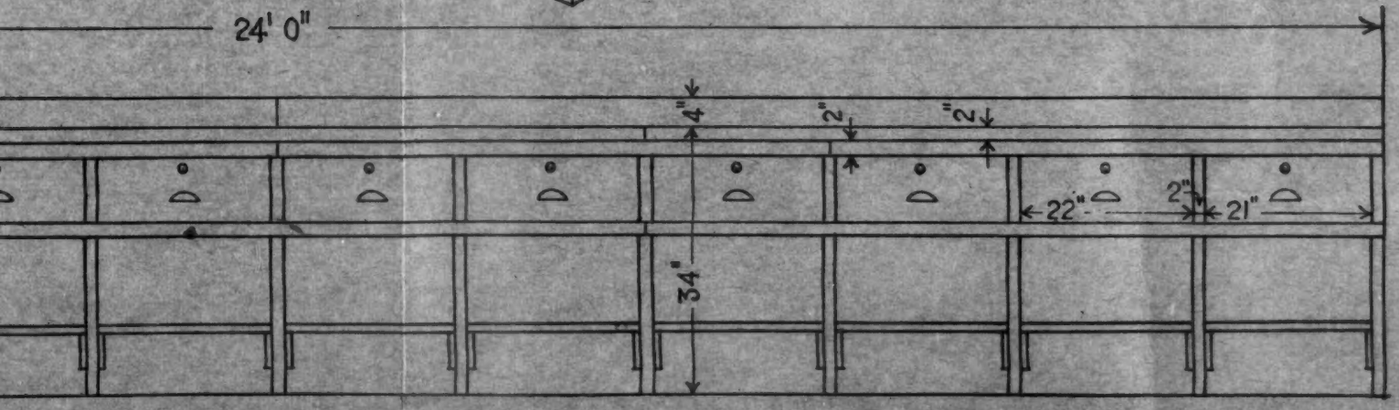

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27—Tractor demonstrations on Saturdays, wading through snow drifts and other stunts will make the farmers sit up and take notice. Plant the seed that grows into a sale later.

28—The automotive dealer has to work Sundays so much, that he should not pass up the opportunity of breaking away at this time of year.

29—If you have a trim shop go after curtain business, it is not too late.

30—Keep the snow cleared away.

31—Get out the monthly statements. Always have some little printed flyer to send along. It helps and there is no extra postage.

1—Keep the snow cleared away. If you haven't such a thing use some of the winter energy to build a service truck. Equip it with all the tackle and tools you can possibly need in bringing in a wrecked car.

2—Ground Hog Day. If he comes out and sees his shadow, "Good Night," six more weeks of winter.

3—A country garage rightly located could operate a camping site with good profit or it might be possible to establish a summer branch at the camping site selling accessories and giving service on tires and minor adjustments. Now is the time to plan such a stunt.

4—There is no good excuse for staying away from church. With the holidays past there will be no more excitement till spring. Enjoy the Sundays. Read MOTOR AGE. Look out for the Chicago show issue, this is the one big bet.

5—Shower baths and lockers for the men are hard to contemplate now but they will mean much to the shop morale next summer when the mercury is flirting with the 100 degree mark.

6—February is the month of heavy snow. Get it out of the way as soon as it falls so that it won't get the best of you.

7—Keep at work steadily on the winter overhauling jobs that you took in either for service or to sell in the spring.

8—Fix up the battery room. Get the stuff off the floor. Neat benches and strong shelves will save 50 per cent of the space and make it easier to handle the work. Junk a lot of that battery rubbish; it litters the place and will never be used.

9—This is a good time to rearrange the shop placing the equipment and machinery to better advantage. Start today to make a plan.

10—It is now time to stage a sale of winter accessories to clean up the stock of heaters, primers and winter apparel. You will loose money if you carry it over. Cut the price and move it out.

11—A Sunday afternoon is always well spent in company with MOTOR AGE.

12—Clean up the shop, throw away all the old broken parts, bolts without nuts and such rubbish. If there is anything really good keep it, of course, but there usually isn't.

13—Keep the snow cleared away.

14—Valentine's Day doesn't mean much to Motordom, but it's a good chance for a clever window display. Some big red hearts will attract attention and cost little.

15—The garage cannot make much from the sale of gas at the curb, but if there is a good accessory display close by, gas sales may lead to accessory sales, this is especially true if the pump man watches his customer and "asks him to buy" when there appears to be a prospect. If you haven't a good display window try to change things around so that one can be arranged and keep it neat and well trimmed. Customers will not notice it unless it has something new every once in a while.

16—Keep at work on the prospect list for the spring car sale drive.

17—Saturdays are always busy around town. It's not a bad idea to get away from the office or shop and mix with the farmers who are always on hand and ready to talk.

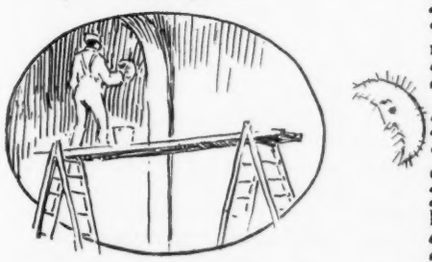
18—Sundays come around pretty often but none too often for there is always MOTOR AGE to be disposed of.

19—How about the parts stock, couldn't some improvements be made in its arrangement. Anyway it could be checked over and shortages noted.

20—Keep the snow cleared away and start the campaign for spring overhauling.

21—Send out literature to prospects advertising new models for spring delivery.

22—Washington's birthday—George should have been chopping down the Governor's cherry tree for several days, or perhaps shooting a few Indians, depending on the resources of the property room.



23—Winter overhauling should be pretty well cleaned up by this time. Next month early birds will be stirring.

24—If you are on a tourist route, equip and tune up for that trade. Tires, gas and oil are their principle troubles. Tools to replace those lost are next. Pliers, screwdrivers and monkey wrenches are, of course, the main items that the tourist will want.

25—It's a good thing every Sunday to take a few minutes and ask yourself what you have accomplished during the past week to improve the business.

26—Re-decorate the showroom before work starts up in the spring. It must be in ship shape when customers begin to get the spring buying fever.

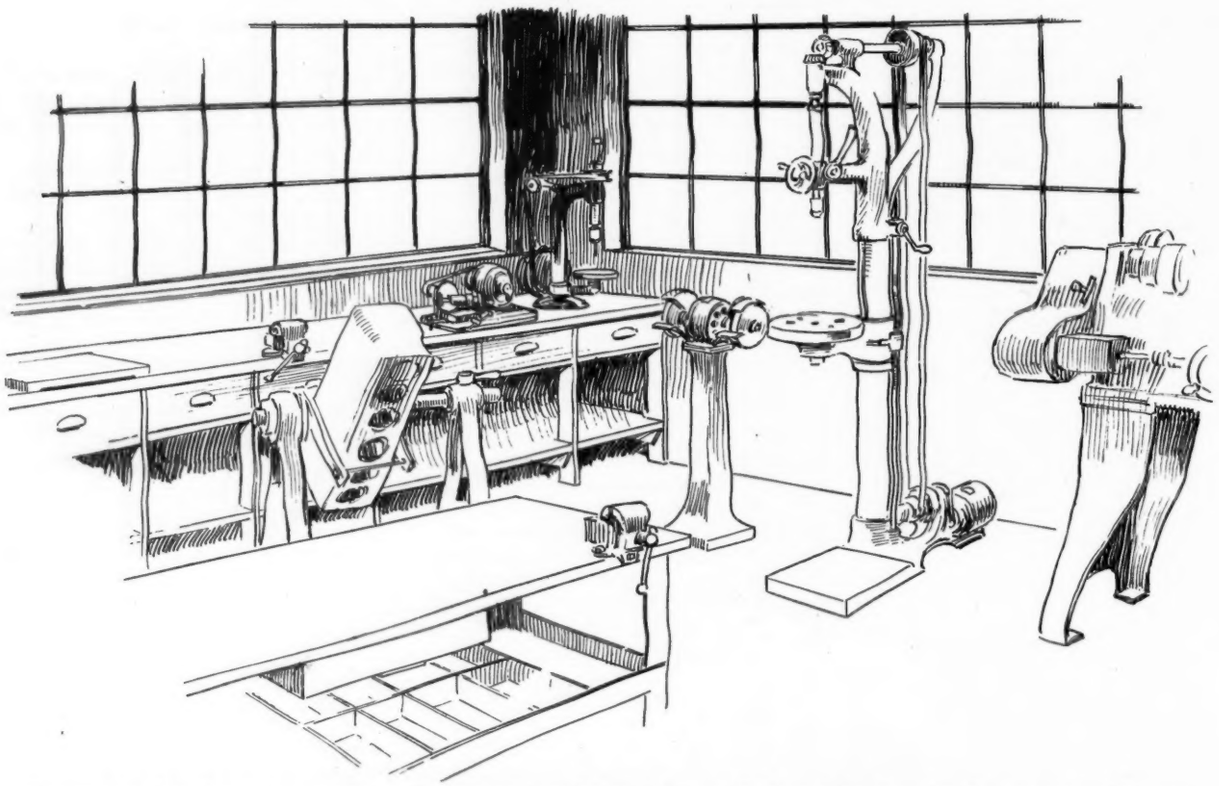
27—Don't try to do all the work yourself. Remember that a man's success is measured not by what he personally does but by the number of others he can keep busy, each one of which earns his own living and a little more for the Boss. If you have had a One Man place try shifting duties to others as they start piling up in the spring. Make each responsible for his department.

28—Get out the monthly statements.

Laying Out and Equipping the Small Machine Shop

If the Shop Is Arranged According to a Well Defined Plan Efficiency Will Follow and Maintenance Will Pay a Profit

By B. M. IKERT



Perspective view drawn in accordance with the suggested layout for an ideal machine shop for the average small town maintenance department

INASMUCH as the shop, by which we mean that part of the dealer's maintenance organization devoted to the actual mechanical operations of tearing down and rebuilding units, is one of the most important factors in the proper handling of maintenance work, it is evident that care taken in the planning and equipping of the shop will result in giving the customer what he wants and make for legitimate shop profits.

In the planning of a shop too little attention is often given to the location of the machine tool equipment. Sometimes the best location of the tools is not possible because the line shafting must govern their placement in relation to the other machines.

Most of the smaller shops throughout the country are fitted with line shafting and sometimes the power for driving is derived from an electric motor or from a gasoline engine. Electric power is available in most every small communities now, and for that reason we have shown the equipment on these pages as individual motor-driven machine tools.

Where each machine is driven by its own motor the machine can be located anywhere it is desired. The cost of individual driven machines is not much greater than that of machines plus line shafting, hangers, pulleys, belts, motor or gasoline engine. Furthermore, individual driven machines make for a much neater installation and, as will readily be appreciated, one machine out of commission will not affect the others.

For those however, who now have installed in their shops machine tools driven from a line shaft, we have arranged the equipment on these pages so that the lathe, grinder and drill press are in line, so that it will be possible to drive the line shaft from a motor or engine somewhere near the corner in which the lathe is placed.

In laying out the shop shown, we have assumed that a space 20 by 24 ft. is available for the shop proper. As a general thing it will be located in the rear of the building. Further assumption has been made that there is a row of windows on two sides of the shop. These are indicated in the plan view on the insert following this page.

It will, of course, be understood that this shop is not large enough to run into, for repair work. It constitutes only the "machine shop." However, the layout is such that a car can be run through the doorway placed between the gate, which is ordinarily used as an entrance and exit, and the cleaning tank.

It is well to run a partition about 5 ft. high around the shop and carry this to the ceiling by means of wire netting. This lets plenty of light get into the shop, make it possible to look into and out of the shop and at the same time prevents anyone from entering who has no business there.

A good thing to bear in mind when placing a lathe is to make some sort of small door or opening in the partition immediately behind the lathe and at a height equal to the centers of the lathe. This allows a long rod to extend through the partition, when it becomes necessary to do lathe work involving long shafts.

A study of the ground plan will reveal that thought has been given to the placement of the various machine tools and other equipment as regards their inter-

relationship. The rectangles and squares indicating the machines, tool cabinet, bench, and other equipment are drawn to scale, which makes it all the easier to understand and appreciate the locations. The floor dimensions of some of the more important pieces of equipment also are printed here, so it is possible to cut paper templates, move these about on the floor to get the best possible arrangement. The arrangement shown here will not fit all cases, but it will be applicable to the majority of small shops. We also have assumed that the shop is to do a general repair business, because this is necessary in the smaller communities where a dealer's maintenance department cannot hope to make profits by selling the maintenance work on only the particular make of car the dealer sells.

The first thing to do after the space for the shop has been selected is to clean up the place and make the necessary repairs which will make for a neat appearing and efficient shop. In a new building this is easy. But in the older structures it may be necessary to do a little plastering on the walls, repair the floors, put in some panes of glass, wash the windows and decorate the walls and ceiling with paint, or some such material as "Barelled Sunshine." The partitions can be painted in some neutral color, like gray or tan. After the place has been put in order it is time to install the equipment.

The workbench is one of the most important pieces of equipment in the shop and as such it is well to spend considerable time in its construction and installation. The men have to spend a great deal of their time at the bench and for that reason it is best to do those things which will insure their working with the greatest dispatch and comfort.

The bench shown here runs the entire length of the shop. The general dimensions are: Height, 34 in.; length, 24 ft.; width, 24 in. There are several ways of building a good bench. Some prefer to take pieces of 2 by 3 in. maple and set them up on edge for the bench top. This makes a very strong bench, but it hardly is necessary to have the rear part of the bench as heavy as the forward part, because little actual work is done at the rear. A great share of the work is done in the vises, and so long as the forward part of the bench is amply strong, little difficulty will be experienced.

Most shops probably will let the planing mill or some woodworker in town build the bench. But, if your shop has a handy man who can wield a hammer, saw, plane, chisel, brace and bit, there is no reason why the bench cannot be made in your shop. The market affords iron bench legs which come in very handy when building a bench. If these are used it is necessary to build the top only.

The bench herewith has been built with twelve drawers, all fitted with

List of Equipment for the Average Small Machine Shop

MACHINE TOOLS AND SHOP FURNITURE

Workbench
Cleaning Tank
Lathe
Drill Press
Bench Drill Press
Floor Arbor Press
Bench Arbor Press
Connecting Rod Jig
Valve Lathe
Vises
Grinder
Engine Stands
Tool Cabinet
Welding Outfit
Portable Workbench

SMALL TOOLS

Wrenches
18-in. pipe wrench
12-in. pipe wrench
6-in. pipe wrench
18-in. monkey wrench
12-in. monkey wrench
6-in. monkey wrench
Set double end S-wrenches
Set 15 deg. double end
Spark plug socket
Ratchet handle socket set
Adjustable 6-in. end wrench
Adjustable 8-in. end wrench
Narrow-jaw monkey wrench
Set speed wrenches
Files
12-in. bastard cut, flat
12-in. bastard cut, half round
10-in. bastard cut, round
10-in. bastard cut, square
10-in. bastard cut, three-cornered
8-in. second cut, flat
8-in. second cut, half-round
8-in. finishing cut, flat
8-in. finishing cut, half round
8-in. finishing cut, three-corner
8-in. finishing cut, rat tail
6-in. finishing, flat
File for contact points
File brush and handles
Measuring Tools
24-in. carpenters' squares
6-in. machinists' square
Carpenters' 2-ft. rule
Machinists' 12-in. scale
Machinists' 6-in. scale
Machinists' 2-in. scale
Combination protractor and square, 18-in.
Spirit level
Thread gage
Thickness gage
Small and large external calipers
Small and large internal calipers
Small and medium spring dividers
Friction joint dividers, large
Internal micrometers and extensions
Micrometers, 3-in.
Micrometers, 2-in.
Micrometers, 1-in.
Dial Indicator
Shears
Tinners' snips
Heavy shears
Bolt cutters
Hammers
Raw hide mallet
Lead hammer mold
Straight pien, 4-oz.
Ball pien, ½-lb.
Ball pien, 1-lb.
Ball pien, 2-lb.
Blacksmith's sledge, 12-lb.
Blacksmith's, 4-lb.
Screwdrivers
Small jeweler's
6-in. blade
10-in. blade
12-in. blade
Offset
T-handle, large
Bench Equipment
Small bench anvil
Swivel vise
Medium pipe vise
Surface plate
Machinists' clam ps
C-clamps
Surface gage
Straight edge
Scriber
Chisels
Cap, large
Cap, medium
Cap, small
Chipping, large
Chipping, medium
Chipping, small
Round nose, large
Round nose, medium
Round nose, small
Cotter pin puller
Diamond point, large
Diamond point, medium
Diamond point, small
Center punch, large
Center punch, medium
Center punch, small
Drift pins, 1/16 to ¾ by 16ths
Pliers
Combination, 8-in.
Combination, 6-in.
Piston ring expanding
Side cutting, parallel jaws
Cotter pin
Miscellaneous Tools
Wheel and gear pullers
Valve spring lifters
Breast drill, two speeds
Valve seat reamers set
Soldering copper, large
Soldering copper, small
Gasoline blow torch
Hand drill, small
Belt punch
Hacksaw frame and blades
Small hand vise
Oil stone
Three bearing scrapers
Three carbon scrapers
Pick-up pliers
Portable electric drill and valve grinding attachment
Piston ring compressor
Special reamers
Expanding reamer for piston pins

This is the shop of the Detroit Cadillac Co., and although in a large institution there is much in the way of cleanliness and neatness that is applicable to the small shop

handles and locks. These are handy for housing the small tool equipment and, inasmuch as many mechanics furnish their own tools, they like to have them under lock and key. All drawers are 22 in. wide, excepting the end drawers, which are 21 in. They can all be made the same width, if the end sections of the bench are built of 1 in. material instead of 2 in.

Three 2 in. by 12 in. by 8 ft. planks will be needed for the front part of the bench top and three boards of the same size, excepting that they should be 1 in. thick, will do for the rear section. The illustrations on the insert show the construction of the bench quite clearly and it is not thought necessary to give an elaborate description here, as to how to proceed.

The drawers are about the biggest job in connection with the building of the bench, but the shop will be well repaid in the neat appearance and usefulness, if the work is carried out according to the layout here. It is an excellent plan to cover the top of the bench with zinc, fastening it in the manner shown. This makes a good surface on which to work and can easily be cleaned. Before putting on the top of the bench the pipe for the compressed air line should be installed and tees placed at intervals from which to carry the air to the top of the bench. Probably four of these connections will be enough. The electric light wires are brought in at the rear of the bench and a receptacle placed about every 6 ft. for plugging in with the lamp. City gas should be brought to the bench and the pipe for this can be run along the top rear upright board. Give the bench a coat of paint, either gray or tan, the same color as was used for shop partitions will do and before mounting the drawer pulls, paint a black rectangle about 3 by 6 in. on the drawer front. Then fasten the pulls into place. This prevents the face of the drawer becoming smeared with finger marks and makes for a neat appearance.

Sometimes the small arbor press is placed on an individual bench. Its auxiliary tools are kept on the shelf below

After the bench has been completed the vises can be mounted. One of these should, preferably, be a swivel vise. They should be mounted at about the places indicated on the layout, as this will save steps.

While on the subject of the bench, we might mention the equipment other than the vises, intended to be mounted on the bench. Near the extreme left hand end of the bench is a small bench arbor press and close to it a connecting rod jig. The small arbor press had been located near the cleaning tank because experience seems to indicate that most parts, after they are cleaned, have to be pried apart and the small press thus comes in handy at the position shown. It is used also for straightening rods and, inasmuch as the engine assembly is done on the engine close by, the rods can be straightened in the press and tested in the jig. For that reason the press and jig have been placed side by side.

In the center of the bench and between

the two vises is a surface block or plate. The small shop probably will want to buy only one of these and for that reason the block should be bought in as large a size as possible. One 20 by 20 in. is a good size. The surface plate is one of the handiest pieces of equipment to install because of its great variety of use in testing and assembling work. Its top must be carefully protected at all times and during the periods it is not in use it might well be placed under the bench or in one of the drawers.

At the extreme right end of the bench has been placed a small sensitive drill. This might be one of the upright bench drills of the permanent type, or a portable electric drill fastened in a suitable stand, several of which are on the market. An electric valve lathe for facing valves and doing similar work is also placed on the bench at this point. The reason for placing the small drill here is because it brings it close to the large drill press and therefore, all drill points can be kept in one place close to each drill. In other words the drilling is localized. Any other drilling necessary can be accomplished by the portable electric drill which can be plugged in anywhere in the shop.

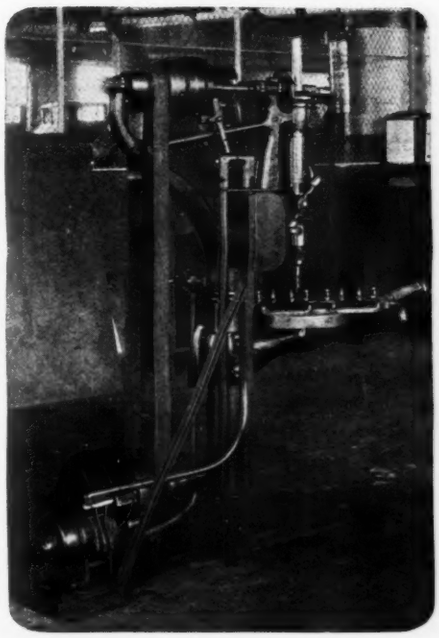
Shop Should Have Cleaning Tank

The small shop certainly should have some sort of cleaning tank in it. One of the greatest troubles in the past has been that mechanics have been asked to work on parts which have not been first properly cleaned. No man can make a good inspection of parts and suggest a repair until the parts have been cleaned. And, it is sheer folly to expect a high-priced mechanic to spend his time cleaning parts by hand.

The market affords excellent cleaning tanks in which entire engines and axles can be immersed. After this it is much easier to take the units apart, as all dirt and foreign matter has been cleaned from the bolt threads. In lieu of buying a tank the shop can make one, providing some way to get heat under the tank for warming the solution. Before attempting to install a tank the shop should find out if there is a local ordinance which may forbid bringing an open flame of this kind into the shop. In many instances steam pipes have to be run into the tank for heating the solution.

The grinder is a tool of utmost importance in the shop and it will be used very frequently, much more so than the other tools. For that reason it is placed close to the bench and between the large drill press and the sensitive drill, because drill points must be sharpened frequently.

There is not much to be said in the placing of the drill press and about as good a position as possible is that between the grinder and lathe. The lathe should be of the gap bed type and be able to swing about 50 in. between centers. If it is equipped with a milling attachment for cutting Woodruff keyways and similar work, and a small tool post grinder, the shop will be in position to handle almost any job that comes in. A lathe always has certain attachments like dogs and arbors, which should be kept in the vicinity and while the lathe is being used these attachments can be kept in wood racks such as shown in two of the accompanying illustrations. Ordinarily, however, it is best to keep the lathe tools in the tool cabinet.

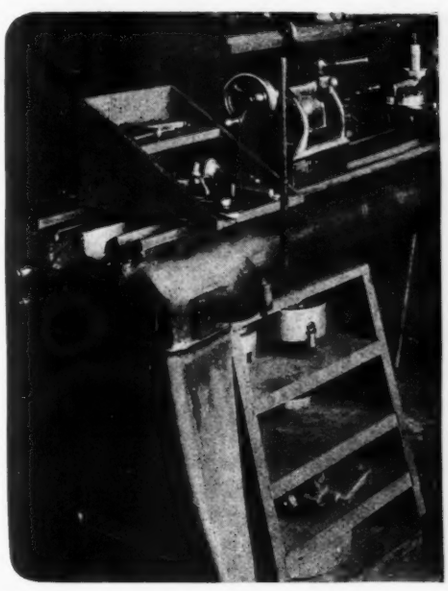


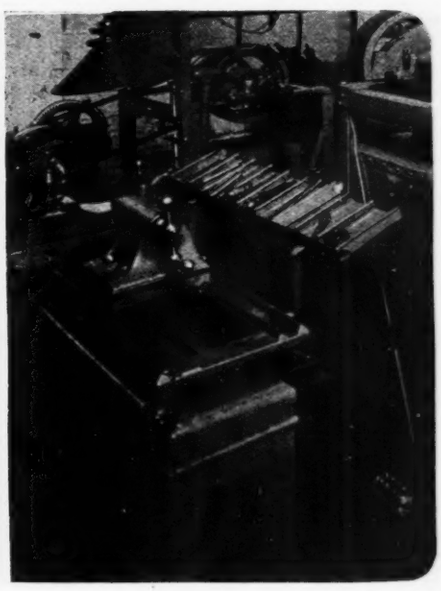
Individual motor driven machine tools like this drill press make for neat installations and convenience

Inasmuch as this layout takes in only the machine shop proper, it is evident that the tearing down of cars and reassembly is to be done at some other point in the building. For that reason, we have shown engine stands of the portable kind. The plan is to remove the engine from a car in the space designated for that purpose and roll the engine stand up to the car. After the engine has been placed on the stand it is rolled to the machine shop where the shop crane lifts its into the cleaning tank. Or, the crane can carry the engine right from the car to the tank and then be used to place the engine on the stand in the shop. It is decidedly handy to be able to move the engine around the shop on a portable stand. It saves many a step.

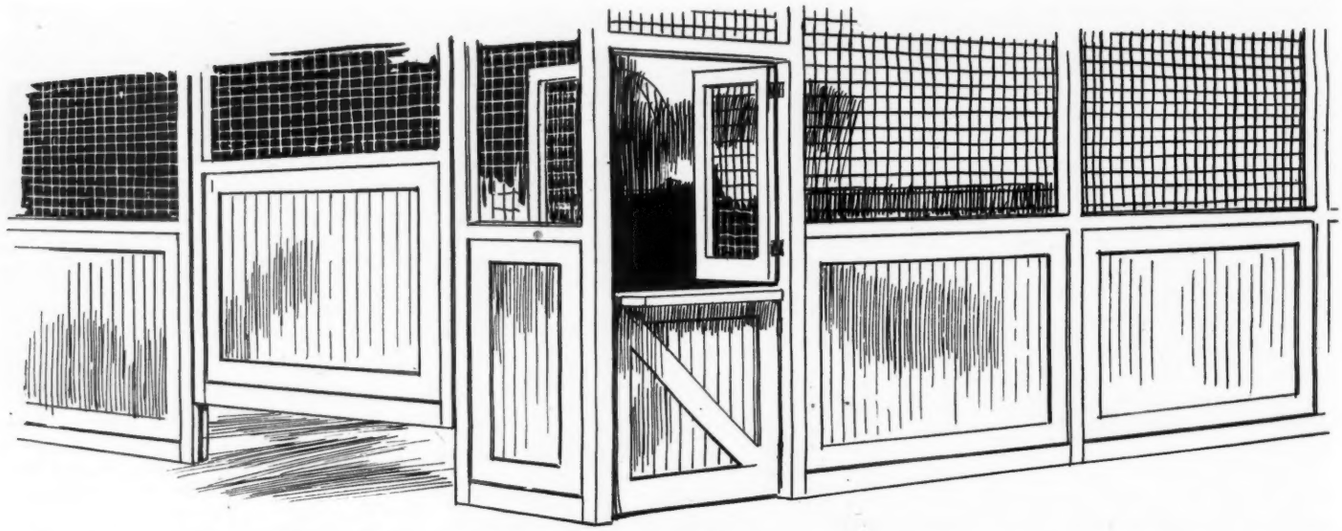
There are any number of excellent stands on the market and the buyer should choose the one he feels is best suited for his work. Some shops make their own engine stands and while these often answer the purpose very well they usually are not quite as efficient or reliable as the article made by a manufacturer who has spent much time and money in designing a stand which will more exactly do the work required of it. Above all the stand must be reliable. It must be so built that an engine will be safe in it. Should the engine be dropped as the result of a breach, it is easy to see that many jobs would have to be taken into the shop to pay for the damage done.

In the center of the shop a portable bench is shown. This is one of the handiest pieces of equipment the shop can install. Like the engine stand, the market affords portable benches which are built with a lower shelf and compartments for tools and parts. A vise also is mounted on the bench. The beauty of having such a bench is that the mechanic does not have to go to the main shop bench every time he wants to perform any of the usual bench operations. A bench like this also can be rolled out to the repair shop proper or "quick service department" when it becomes necessary.





Tool racks like this come in handy for keeping the lathe tools and parts in order. They are easily made and there is always a place for everything



Construction of the shop partition. Ordinarily the entrance is by the small gate, but for moving in and out machinery, or a car, a section of the partition acn be raised and lowered as shown

A large arbor press has been placed in the position shown in the plan because such a press does not need to be placed in direct light like the lathe, drill press and some of the smaller precision machinery. The arbor press is a most useful piece of equipment and most shops prefer the portable type. This makes it possible to take it anywhere about the establishment, but ordinarily it does not have to be moved from its position.

One place where a good many shops fall down is in the way they handle their tool equipment. Too often the special tools, such as reamers, files, bearing line reamers and blow torches are left carelessly about the shop or are housed in boxes placed under the bench or in a corner. The only way to keep such tools properly is in a tool cabinet.

The plans in the insert show how a tool cabinet can be built. All the necessary dimensions are given and there should be little difficulty in making it. The chief thing to bear in mind is not to "throw it together." Make it a real job. The men in the shop will do far better work and take more pains with their daily shop tasks if their equipment is cared for in an orderly manner, to say nothing about the time saved in looking for a particular tool.

Usually a cabinet 10 ft. long, 2 ft. wide and a little over 5½ ft. high will take care of the tool equipment of the small shop. The cabinet shown is made with six shelves, including the bottom one. By dividing the cabinet into three sections it is possible to group the tools and fixtures a little better. For example all the tools like reamers can be kept in one section, the special wrenches in another and so on. The heavier tools and equipment can be kept in the lower compartments. One of the illustrations shows how the shelves can be subdivided to accommodate files, drills, chisels and other small tools. These subdivisions will help to keep the stock from becoming disarranged.

It is well to equip the cabinet with hinged doors for the top sections and by all means put locks on the doors. All of the wood used for making the cabinet is ¾-in. thick, excepting the door panels which can very well be made of ¼-in. material, either wood or plaster board.

There is nothing that will make a shop look more tidy and business-like than a well built bench and tool cabinet. Machine tools usually are fine looking pieces of equipment in themselves, but their looks are greatly enhanced by the neatness of the other shop equipment. If you don't get the point take a sensitive bench drill, for example, and place it on a dry goods box. Then place it on a metal covered, painted and well built work bench such as here described. You will get the difference. True, the drill will work as well on the dry goods box, but this sort of installation does not help shop morale. The trouble has been in the past that we have contented ourselves with letting the high priced tools lie around on the floor. Some of the tools cost as much as a surgeon's instruments. He keeps his in cabinets with glass shelves. We don't need glass shelves in the shop, but we have to learn how to keep equipment properly.

Many will, no doubt wonder why we have not included certain kinds of equipment in this layout. It is because we have tried here to give the best arrangement and outfit of machinery and tools which the small town place can profitably install. There are those who will say that a shop of this kind should have a power driven hack saw, let's say. In the general purpose shop such a saw will probably prove profitable, especially if a little manufacturing is done on the side. But as long as the shop is fitted with a lathe and hand saws cutting off operations can be performed profitably with the equipment at hand.

We have not shown a welding outfit in the plan view of the shop, but this certainly should be included in the general layout of the maintenance department. The welding outfit usually is portable and as such can be kept wherever convenient. Probably a small forge, 100 lb. anvil and tongs will be added by some shops, but unless there is a man in the shop who is skilled in this kind of work it is better to farm it out to the blacksmith. If a great deal of forge work is necessary on a part it may be cheaper in the long run to replace it with a new part. As long as there is a welding outfit in the shop the forge can be dispensed with. The shop might do a little an-

AVERAGE FLOOR SPACE NEEDED FOR SOME OF THE MORE COMMON MACHINE TOOLS AND EQUIPMENT

Engine Stand	33 by 40 in.
Large Arbor Press	36 by 14 in.
Electric Grinder	11 by 14 in.
Drill Press	15 by 41 in.
Lathe	110 by 26 in.
Connecting Rod Jig	20 by 18 in.
Small Arbor Press	10 by 18 in.
Surface Plate	20 by 20 in.
Sensitive Drill	14 in. 8 in.

One of the best plans to observe in laying out a shop so far as the equipment is concerned is to cut paper templates corresponding to the floor area required by each machine and then juggling these around until the best arrangement has been secured. Bear in mind, however, that plenty of clearance must be allowed around each machine. The above figures, for instance, are for the bases of the machines only.

nealing, but this can be done with a Presto-O-Lite tank.

Overhead carriers are handy, but here again it is not likely that the small shop will install one because of the expense involved and also because a shop crane will answer the purpose well enough in such a plan. Of course, where the volume of work permits, a carrier is invaluable. In fact the plan herewith is such that a carrier easily can be made to run into the shop at the gate and over the cleaning tank, then swing around to the right over the engine stands. Where the small town dealer sells considerable maintenance work on a popular make of car, he probably would be justified in adding an overhead carrier to his list of equipment.

There are many special kinds of tools and equipment which the shop itself can make and install. This will depend upon the ingenuity of the men. For instance, brake lining is a job that can be performed very well on a dummy brake drum. A support for the drum can be made out of cast iron and the drum itself fastened to it by a few cap screws. Such a drum is handy for hammering the bands to a true circle before they are relined. In the same way it is possible to make up a dummy clutch drum, if the work runs particularly heavy on one make of car.

The man skilled in lathe work will make a lot of things that speed up operations. He can make fixtures for holding pistons, off sets for crankshaft turning. If he has a tool post grinder he can do inside grinding on surfaces that ordinarily would be only machined in the usual way.

No special equipment has been shown to take care of rear axle work. But here again it is possible for the shop to make a suitable support in case a axle has to be brought to the machine shop. There is space in the shop for handling a miscellaneous kind of work and like the engines the axles can be brought in by the shop crane. There are axle stands on the market which are more or less universal and which are highly desirable if the shop sees fit to spend a little more money on equipment. An axle, like an engine, is a rather cumbersome thing to work upon unless it is properly supported so it can be turned into any position.

The small tool equipment listed on these pages is for the shop only, that is, they are not tools for the mechanics to carry around with them in their kits. The list of files, punches and chisels can be doubled or trebled as the business warrants.

How's the Accessory Display?

"A well arranged accessory show case, kept clean and in a presentable condition, stocked with an attractively displayed array of accessories, will pay for itself within a few months without any sales effort on our part beyond making the display," says a dealer who has in his salesroom a glitteringly clean case containing such a display of accessories. Still another dealer, convinced that an attractive accessory display brings trade, utilizes one of his two big show windows for accessories, and says he has been amazed at the hundreds of dollars in sales that have thereby been added to his business.

Good Displays Build Business

In fact, it is obviously certain that those small town automobile dealers who pay attention to their accessory displays, who keep them clean and up to date, have developed an accessory trade which is worth while and profitable. Almost without exception such dealers testify to the wonderful selling influence exerted by such displays.

Contrariwise, dealers who neglect their displays, who allow dust and dirt to accumulate over not only case but the parts, who are slovenly and indifferent about the matter, almost as invariably have no good word to say for the accessory business. It is unfortunately true, also, that dealers of this latter class preponderate in numbers in the small communities.

How severely the accessory business in the small towns is suffering because so large a proportion of the dealers neglect this department of their business and because, if an accessory display is made at all, it commonly is poorly arranged and quite as commonly is filthy and unattractive, no one can realize who has not himself come into contact with the facts.

In a recent survey which covered a dozen or more such towns in a populous and prosperous mid-western state, something more than 50 dealers were called upon. Most of these dealers made more or less of a pretense to selling accessories, but in a majority of instances pretense was about as far as they got. After seeing dozens of dirty show cases and dozens of haphazard displays of accessories, only wonder is left as to how some of these dealers manage to get across at all or how they can justify their slovenly attitude toward a department of the automotive business which might so easily be made profitable for them all.

The crying need in such towns is for a "Clean up" campaign to be effectively hooked up with "Ask 'em to buy." Most dealers have heard of and have been more or less impressed by the campaign for the latter, but too few have been sufficiently impressed to have taken any active measures, at least as far as the display and appearance of their accessory stocks are concerned, to make it effective.

Get Beyond Pretense Stage

There can be no manner of doubt that if the small town automobile dealer can be induced to clean up and to get beyond the pretense stage as respects accessories, his business on such parts will be increased tremendously and more dealers will make more money. Those dealers who have some conception of the selling influence exerted by an adequate and attractive display of accessories and who manifest a faith in the value of their own convictions, are finding this demand to be constantly increasing and to be progressively profitable. None of them who have had this experience manifest the slightest disposition to return again to the older and more slovenly ways.

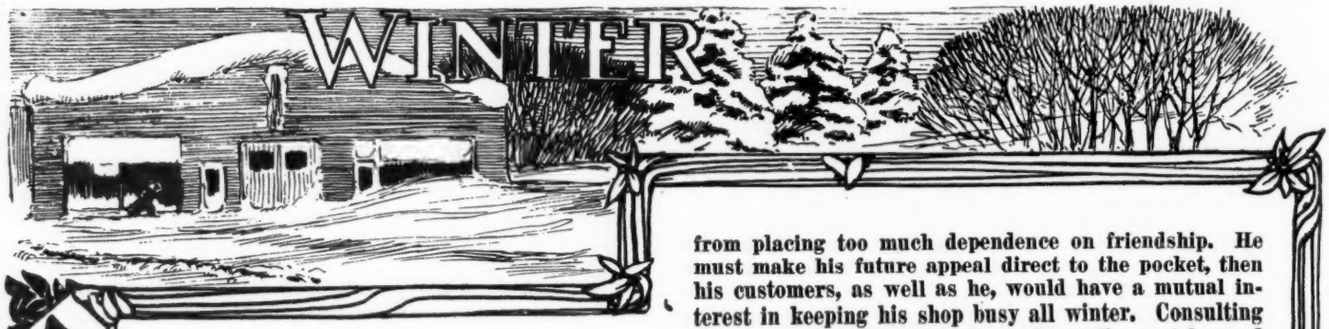
The bulk of the cars which most need accessories to doll them up are sold in the smaller communities. By the same token the bulk of the accessories would be sold there also. But this never will be the case until the small town dealer gets the conviction into his head that this is so and then cleans his place up and goes after the business. By all means, get the "Clean Up" campaign under way.

Reading Business Paper Brings Profit

How the latent possibilities of the automobile accessory trade can be developed by means of an attractive window display is being demonstrated by the Snow Automobile Co., Ottumwa, Ia. The company's salesroom faces the main business street of the town, and one of the two large display windows is devoted exclusively to standard accessories. Norden Snow, president of the company, gives the trim of this window his personal attention, with the result that the effect is attractive and alluring. The accessory trade of the company has been increased by hundreds of dollars a month since the window was put in.

"Never Sold on Windows Until—"

"I never was sold on window displays of accessories," says Snow, "until one day my attention was attracted to a picture of such a display in one of the Class Journal papers. We had recently moved in here and had this big window with nothing to put in it. I decided to try the accessory display. To say that I have been amazed at the results is to express it but mildly. Now I change the trim every two or three days and keep the window illuminated at night until about midnight. We're on the principal street here and hundreds of people pass the window daily. They see the display and then come in and buy voluntarily. It's put our accessory business on the map. I don't clutter up the window with too many things at a time nor do I placard the display with price tags, but I do try to make the display show only standard accessories which for the most part have been extensively advertised and so are familiar by name to most of my customers. That's our method of asking 'em to buy, and it works."



ONCE upon a time there was a man who lived by repairing vehicles. He was an honest and industrious fellow and did not have an enemy in the world. While he had no human enemies, his abode and workshop were in the great hill country where old King Snow reigned with an icy hand spreading his blanket of winter, silent and bleak, over forest and town alike. Old Snow was not unkind to the Man any more than to others, but no matter how hard the Man worked during the good weather, he was forced by Snow to remain idle for many months during which all the fruits of his thrift were consumed. Each spring he was forced to make a fresh start because the long period of expense without income had used up all his surplus.

Every year the man resolved to master Snow but every year Snow caught him napping and mastered him instead.

Finally, the man swore an awful oath unto himself and started in earnest to get the better of Old Snow for he realized that as long as Snow kept him buried for half the year, just so long he would be poor and humble. He sought out all his friends and implored them to let him have their vehicles and store them that he might repair them, while Snow was King, arguing that in this way there would be no lost time when the roads again became passable; which was very true and a good argument and they all agreed it would be a mutual benefit.

The man was in high glee and gloated openly at his prospective victory over Old Snow. But the frosty days of Indian Summer with their red foliage and azure skies were most delightful and the man's friends and patrons were loathe to part with their wagons while there was yet chance of a joy ride; so it happened that Snow, the crafty old Sinner, slipped down in the still of the night and spread his net far and wide over the countryside and the chug and whirl of conveyances was heard no more in the land. And Lo, the man's victory was vanished and turned into defeat and he crawled out of the little end of his horn of plenty.

Old Snow laughed long and loud that winter, his merry ripling howls floated through the cracks and down the chimney, and echoed through the windows and around the empty shop. But the Man was a hard fighter and the louder Snow laughed and derided him, the more he swore he would be master even if it took unto the end of his days.

With grim determination, after he had recovered from his first disappointment, he set about planning the downfall of his enemy. There was naught else to do that winter so he took plenty of time to the job.

His first act in the new plan was to put the scheme on a business basis as he realized his last failure was from placing too much dependence on friendship. He must make his future appeal direct to the pocket, then his customers, as well as he, would have a mutual interest in keeping his shop busy all winter. Consulting the Sacred records of his Uncle Samuel's most learned weather prophets, he learned that the fifteenth day of November was the last day it would be safe to expect open roads and fixed that day as a deadline after which no winter work could be received to be done at the cut rate.

Liberal discounts were to be offered on general overhauling, painting and retrimming but unless the vehicles were in the shop before the fateful day there would be no discount.

The Man was indeed proud of his plan and engaged himself daily and nightly penning scrawls which were to be posted by R. F. D. at intervals during the months of October and early November, advising customers of his intentions.

He also made lists of the dwellers for many miles around, placing beside their names many items of interest to know, such as the make of their car, its age and condition.

Thus it came to pass that as the days began to lengthen, the man was all set so that he took scant account during the busy season but when the frost was in the treetops he got out his records and with the aid of his trusty stenographer, set about the downfall of Old Snow.

And behold, the people of the hills responded with such good will and in such great numbers, that the Man's storehouse was filled even to bursting, so that they had to bring timbers and set the cars above one another that there might be room for all those that wished to enter before the doors were closed.

Thus—When Old Snow entered the valley wherein the Man's shop stood he emitted a great roar.

But it was not of laughter as before.

But out of the other corner of his mouth.

For he saw by the merry fire and the busy shop

That he had indeed been defeated.

Dort Four Practically Unchanged for 1923

Car to Be Made Along with Six-Cylinder Just Announced. Hood and Radiator Slightly Altered on Four. Prices Also Reduced.

EXCEPTING for a slightly higher hood and substitution of a nickeled radiator, the Dort Four will be manufactured, practically unchanged, along with the new six-cylinder model just announced. Like the new six, the four will be made in six body styles—five-passenger phaeton, roadster, Yale sedan, Harvard sedan, Yale coupe and Harvard coupe. Probably the most conspicuous change in the four is the reduction in price, the different models selling as follows, f. o. b. Flint, Mich.:

Five-passenger phaeton, $865.
Three-passenger roadster, $865.
Two-passenger Yale coupe, $1020.
Five-passenger Yale sedan, $1070.
Three-passenger Harvard coupe, $1240.
Five-passenger Harvard sedan, $1370.

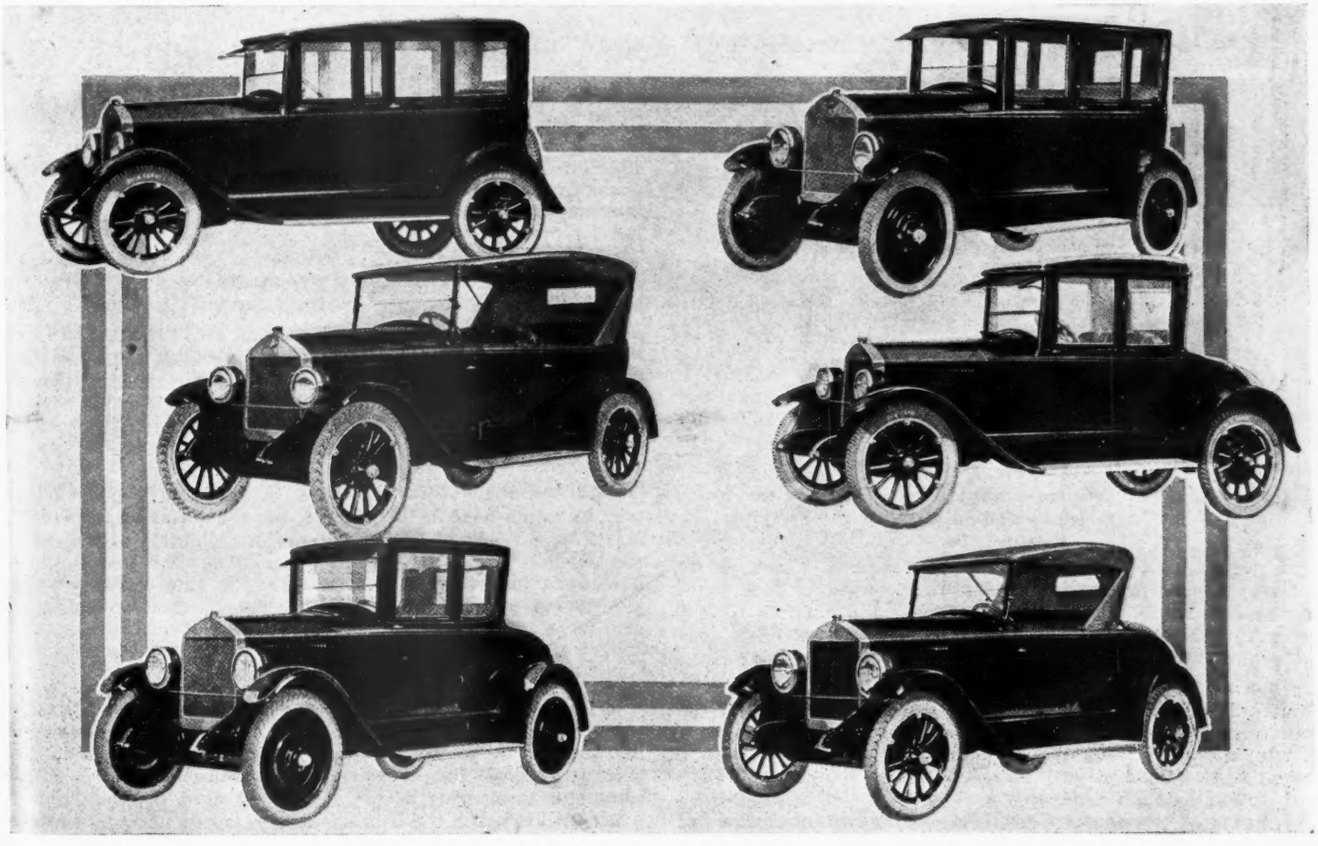
The body styles are identical with those of the new six-cylinder models and there is offered to the dealer, therefore, a wide variety of models ranging in price from $865 for the four-cylinder phaeton and roadster, to $1495 for the six-cylinder Harvard sedan. Drum type headlamps, nickeled radiator shell and door handles and crown fenders add much to the appearance of the new line of fours. On all of the closed models a sun visor, cowl ventilator, windshield cleaner and heater are offered as regular equipment. On the Harvard coupe and sedan five disc wheels also are included in the regular equipment.

The wheelbase of the four-cylinder is 108 in., which is 7 in. shorter than the six.

Among the major units there is a Lycoming engine, 3½ by 5 in. bore and stroke, giving a piston displacement of 192 cu. in. and 19.6 hp., N. A. C. C. rating. Cooling is by thermo-syphon through a Fedders radiator. The oiling system is of the splash type. A 12½-gal. capacity fuel tank is placed at the rear and fuel is fed to the Carter carbureter by a vacuum tank.

The electric system is Bosch for starting and lighting, with Connecticut ignition. The clutch, a Detlaff, and gearset are in unit with the engine. The rear axle is a ¾ floating type having spiral bevel gears with a reduction of 4.66 to 1. The drive is taken through the rear cantilever springs. The front springs are semi-elliptic. Cord tires, 31 by 4 in., are regular equipment.

In the October 26 issue of MOTOR AGE, it was inadvertently inferred that the line of four-cylinder Dort cars was to be discontinued, when the announcement came that the Dort company had added a six. This, however, is not the case.



The upper left cut shows the Dort Yale Sedan, the right shows the Harvard Sedan, the center left illustrates the five-passenger phaeton, the center right shows the Yale Coupe, the lower left shows the Harvard Coupe and the right shows the three-passenger roadster

Profitable Opportunities in Radiator Maintenance

Intelligent Handling of This Repair Business Is Best Attained When Both the Function and Construction of Radiators Are Thoroughly Understood

By A. H. PACKER

Maintenance Data Giving Make, Water Capacity, and Other Data on Radiators of 1922 Cars Will be Found on Page 96

CARELESS car users, leaving out until tomorrow the alcohol that should have been put in today, continue to insure the radiator shop a rush of business at the time of the first freeze, while rough roads and the hand of time, to say nothing of all too frequent wrecks, continue to supply a line of work the year round.

Several other factors combine to make radiator repairing a profitable business when properly handled. One of these is the cost of new radiators, which makes it advisable to pay a reliable radiator repair shop a substantial price for a good job, rather than buy a new radiator. Another factor insuring a shop in a good territory a dependable amount of business, is the fact that radiator repairs can not be made by anyone,

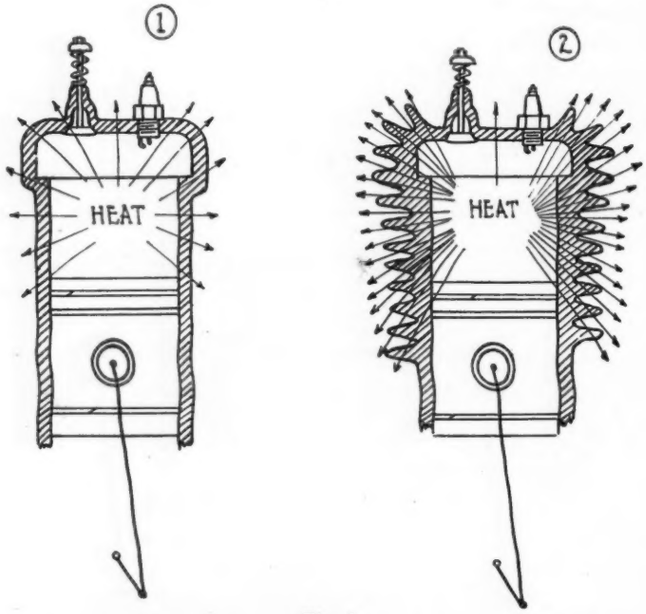


Fig. 1
Simple air-cooled engine will overheat due to insufficient radiating surface

Fig. 2
Air cooled engine. Sufficient cooling obtained by cast fins which increase radiating surface

as a certain amount of equipment is required, which, while not very expensive, is not available in the owner's back yard, nor yet in his garage. The average repair shop is also a potential customer for the radiator expert, lacking as it does the proper equipment and men experienced in this work.

When it comes to the question of experience, it is well to point out that a knowledge of soldering as well as radiator construction is essential to good work, and yet neither is difficult to attain. In fact, there are radiator core factories that are willing to train all-around mechanics in this work if they wish to handle their product.

While it is possible to do repair work without knowing much about the product being repaired, it is far from the best way of proceeding, and the wideawake mechanic will always welcome the chance to acquaint himself with the background of his work as well as the best methods of making the solder stick. The basic facts underlying engine cooling will, accordingly, be of interest.

What the Engine Does

The energy contained in a mixture of gasoline vapor and air is capable, by combustion, of producing heat. The universal effect of heating a gas is to cause it to tend to expand, in which effort it exerts a pressure. We, therefore, find that in the gasoline engine the fuel produces pressure and heat. The pressure, of course, is the useful product and does the work that drives the car, while the heat is generally an unavoidable evil, so that some means must be obtained for cooling the engine to keep it from becoming excessively hot. Excessive heat tends to destroy the lubricating oil, and also expands the parts, such as pistons and rings, to the point where there is danger of their binding and preventing free operation of the engine.

We, therefore, have heat continuously produced inside the engine cylinders and must find some way of dissipating it to the surrounding air fast enough so that undue temperatures are not reached. Accordingly, all automobile engines are air cooled, although this description is commonly applied only to those that do not use an intermediate substance, such as water, to which the heat is first transferred before being liberated into the surrounding air.

In Fig. 1 we have a simple type of air cooled engine, which we know will overheat, however, and yet it would appear as if the heat could pass through the cylinder walls to the outside air. The difficulty is, that while conductivity of heat is possible in this simple construction, yet it does not occur fast enough, so that the engine parts continue to heat up until the lubrication is affected and the engine is ruined.

How Heat Is Transferred

For our purpose we will consider two ways in which heat may be carried or transmitted from one body to another. The use of a wooden handle on a soldering iron illustrates the way in which heat travels through metallic bodies, the heat from the tip travelling up toward the handle. The wood, however, is a heat insulator and keeps the metal worker from getting his hands burnt. When heat is transferred in the mass of the body, as illustrated by the soldering iron, it is said to be conducted.

Observation of oatmeal boiling in water gives us another way in which heat is transferred, for the water at the bottom of the pan becomes hot and, therefore, lighter, and rises to the surface while the cooler water from the surface flows downward to the bottom of the pan. In this way the whole pan of water is gradually heated. This method of heating is said to be by convection.

Conductivity of Metals, Air and Water

Referring now to our simple engine illustrated in Fig. 1, it would be necessary for both the iron walls of the cylinder and the outside air to be good conductors in order to carry the heat away. We find, however, that while the iron is a fair conductor that air is a very poor conductor, in fact the heat will travel through the iron about 600 times as fast as through the air. In our simple engine the result would be that the heat would travel through the iron and heat up a very thin layer of air, but if there should be no circulation to the air, the

transfer of heat would stop and the engine would overheat. We can, therefore, see the need of good air circulation in air-cooled engines especially, so that heated layers of air next the metal may rapidly be replaced by cool air.

As the cooling effect of air is slight, due to its poor conductivity, it is necessary in some way to get a larger surface for the purpose of cooling. One way of doing this is seen in the air cooled engine of Fig. 2, where the outer surface of the cylinder is made with fins or thin cast projections, which increases the effective radiating surface. As the conductivity of iron is fairly good, the heat readily travels from the inner surface of the cylinder through the walls to all parts of the outer surface, including the fins.

This construction, combined with rapid change of air across the fins as would be obtained by using a fan, gives sufficient cooling under most circumstances. One common application of this type engine is on motorcycles, where the motion of the whole machine provides the rapid change of air required, while on motor cars, one or two well-known makes illustrate that this type of cooling can be successfully employed.

What the Radiator Does

There seem to be certain conditions that limit the amount of heat that can be dissipated by air cooling. These are the amount of radiating surface that can be secured and the rapidity with which the air can be changed. The preponderance of cars designed for water cooling seems to indicate that water cooling does not involve such close design and that it is much easier to get proper cooling conditions.

Such an engine is illustrated in Fig. 3, where the radiating surface of the cylinder itself is no more than in our simple engine of Fig. 1. However, in this case the cylinder is surrounded with a water jacket to which the heat flows. Instead of depending on dissipation of the heat by conductivity, we find that expansion of the heated water in the cylinder jackets will cause it to rise, and this circulation keeps bringing cool water into contact with the cylinder walls. In the strictest sense, the water does not cool the engine, but does convey the heat away to the radiator, where the surface is so great that no trouble is experience in letting the heat spread into the surrounding air. Note, however, that sooner or later the air must receive the heat that is liberated in the engine cylinder. In the case of motor boats there is an exception to this rule, for a continuous supply of cold water is available.

Radiator Surface

The radiator shown in Fig. 3 is a rather crude affair, consisting of a tank only. Practically the only surfaces that are effectual are the front and rear of this tank or radiator. Heat from water in the center of this radiator can hardly get out, due to the poor conductivity of water. It is for this reason that modern radiators are designed to allow the water to flow in small quantities, through narrow pipes or cells, where each layer of water can be in contact with a layer of metal cooled by the outside air. One thing, then, that will materially determine the cooling ability of any radiator will be the number of square inches of its structure where water is in contact on the inside and air on the outside.

Conductivity of Various Materials

The operation of any radiator depends on both conductivity of heat through the metal and the ability of the air to absorb the heat In this connection it will be interesting to consider the ability of various materials to transfer or conduct heat through themselves. The relative conductivity of materials with which we are most interested is as follows:

Silver	10,000
Copper	7,360
Brass	2,310
Iron	1,200
Water	10
Air	2

These values are merely comparative, with silver taken as an arbitrary standard, due to the fact that it is a better conductor than any of the others. Silver, due to its cost, is of course out of the question as a material for a practical radiator, but copper and brass are both used. Copper is somewhat more expensive, and softer, but withstands the corroding effect of alkali water better than brass. Most radiators, however, have cores of brass.

Knowledge of Construction Necessary

The art of repairing radiators depends on two things; one is the ability to solder; the other is a knowledge of radiator construction. The latter qualification can best be obtained by getting some junk radiators from any wrecking concern and tearing them apart to see how they have been put together. Then after some idea of the construction has been obtained, another junk radiator should be tackled with the idea of repairing it if possible.

Definitions of Various Radiator Types

In trying to find what construction is really meant when the words tubular, honeycomb, or cellular are used, it was found that there were as many ideas on the subject as there were persons questioned. For our purpose, therefore, we will give the following definitions:

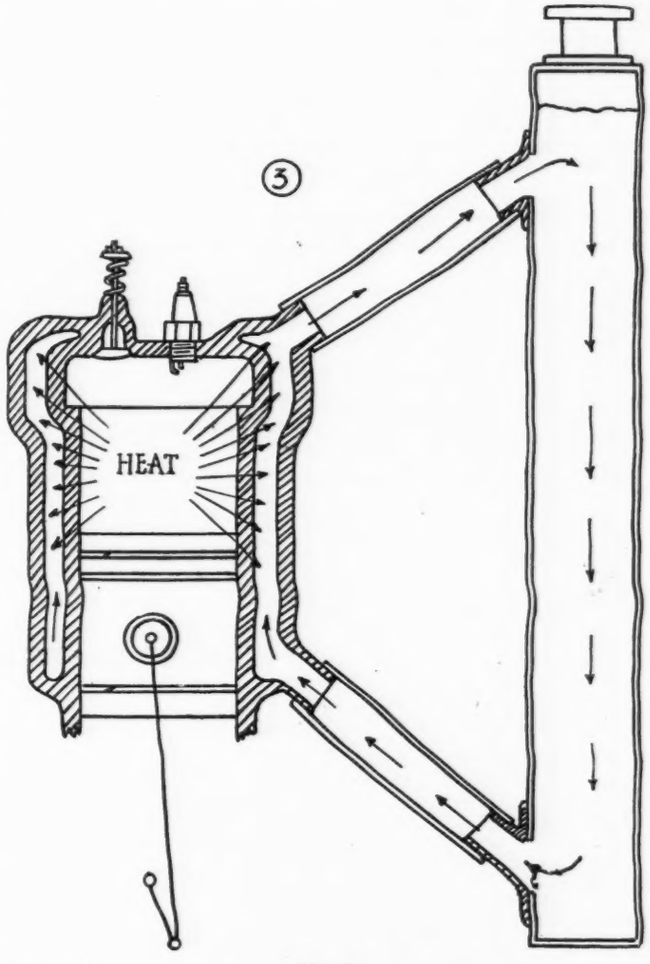


Fig. 3
Water cooled engine. Cooling surface of radiator much greater than available surface of cylinder

Fin and Tube Type

The fin and tube type radiator core is one made up from continuous water tubes over which are fitted fins, which are not integral with the tube. (They must, however, be soldered to the tubes.) The tubes may have various shapes of transverse section, but are not crimped and are not of that wide flat type which is formed by joining two metal ribbons at

each edge. (Tubes may be round, oval, rectangular or of other section.)

Ribbon-Cellular Type

The ribbon-cellular type of radiator core is one made up from continuous water tubes formed by joining two metal ribbons at each edge. The walls of the tubes are usually crimped and are so grouped as to form a cellular structure. In some cases a part of the cellular structure is formed by flat or crimped ribbon which is not a part of the water tube walls.

Air Tube (Cellular)

The air tube (cellular) type of radiator core is one made up from air tubes which are nested in such a way as to form water passages between the tubes, these passages being sealed by solder at the ends of the tubes. In this type of core the general direction of water flow is at right angles to the tubes but the water can flow transversely (crossways) as well as vertically through the passages between tubes. This type is also often called

Honeycomb or True Cellular

As previously stated, the best radiator from a cooling standpoint only will be one which has the maximum area of metal exposed to the water on one side and to the air circulation on the other. The Air Tube or Honeycomb type of radiator fulfills these conditions. A typical construction is shown in Fig. 4, where a large number of square tubes, flared at the ends were soldered together as shown, air going through the center of the tubes and water flowing over them, through the passages left between them when the flared ends were soldered together.

In the lower part of Fig. 4 it will be seen, in the sectioned portion at the right, that water can flow down through the

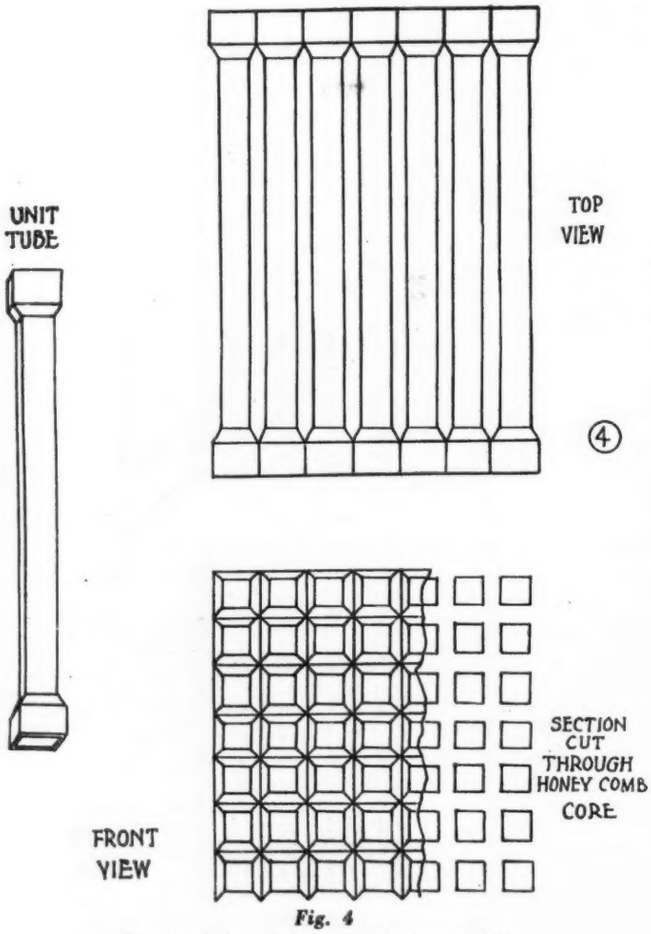


Fig. 4
True cellular or honeycomb type radiator

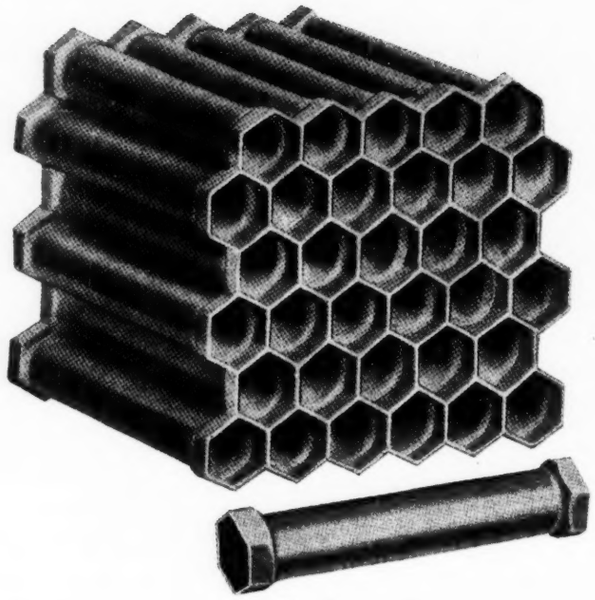


Fig. 5
The cartridge type radiator. A true cellular or honeycomb construction

vertical passages, and can also flow in and out at the cross passages. The actual flow will be a combination of downward streams combined with eddy currents in the side passages, which whirling motion will be most effectual in supplying hot water to the cooling surfaces, and together with the area of cooling surface available makes this type very efficient. The type of core shown in Fig. 5 is also true honeycomb, being made of round tubes, flared to hexagonal shape at the ends.

Expense of Honeycomb Construction

From Fig. 4 or Fig. 5 it can be seen that considerable labor will be involved in assembling a quantity of these individual tubes, so that the expense will be much greater than in the cellular ribbon type which is made from strips of metal.

In making the radiator of metal strips, the construction is often such that all metal portions do not carry water, one such type being illustrated in Fig. 6. In the lower right hand view the three essential components are shown. C gives a section through one half of the water tube. B shows the same piece turned the other way, but not shown in section, the way in which the ends are bent together also being shown. A is a plain strip of brass or copper which is used in the construction to simulate the honeycomb appearance at the front and also to give additional indirect radiating surface.

In the lower main view of Fig. 6 will be seen the way in which the pieces at the right are assembled to make up the radiator core, while above is shown a top view of the same assembly. Comparing this with Fig. 4 it will be seen that there are just half the number of water passages, but that the water in descending, will have the same chance to produce eddy currents due to the side passages shown in the sectional portion of the front view of Fig. 6.

The area of cooling surface appears in Fig. 6 to be just three-fourths of that of Fig. 4, but the cooling ability will be better than this due to the fact that the strip A known as a "false tube" or "idle perpendicular," carries heat from the "laterals" or projections from the main water passages. Now when we consider the rate of heat conductivity given in the table it will be seen that either brass or copper carries heat so much better than the water that these false tubes will be quite effectual in radiating heat.

Aside from reduction in cost of construction, the use of vertical copper or brass strips in the radiator construction usually gives greater strength or rigidity, which is quite as important as cooling ability, for a theoretically fine radiator

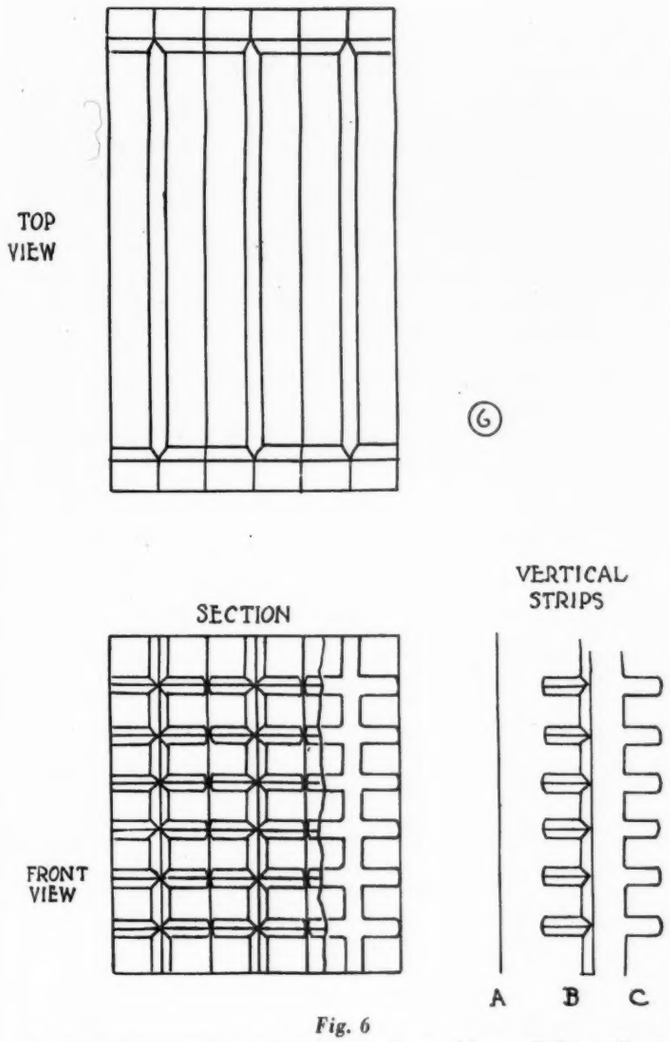


Fig. 6

Apparent honeycomb construction, really a ribbon cellular radiator

would be no good practically if the soldered seams were continually opening.

In Fig. 7 a type of radiator construction is shown which is in reality tubular and in which a honeycomb appearance is obtained by a crimped spacer shown at "B" which helps conduct the heat away from the tubes and at the same time supports them. Here the cooling action would appear to be less than in either Fig. 4, Fig. 5 or Fig. 6, as the area of false tube is the same as the real tube area, and there are no side passages for the water. In Fig. 8 another construction is shown in which the shape of the vertical strips is such that there are water passages around all of the air cells, so that the cooling action should apparently be equal to that of the ideal honeycomb type.

In Fig. 9 is shown another construction of the cellular type, in which all air spaces are surrounded by water passages.

Tubular radiators as shown in Fig. 10 and 11 are easily understood. They are used on many cars. The type shown in Fig. 11 has an advantage over the type with circular tubes in that there is but little likelihood of the tubes bursting due to freezing, because of the fact that expansion is possible. With the round tubes, however, freezing is more likely to result disastrously.

The Repairing Process

The actual work of repairing a leaky radiator is so tied up with the process of testing that the two must be considered together. We will accordingly look at the repair shop shown in Fig. 12 and assume that we have the job to do in this shop.

The tank here shown is suitable for the wet test process where the radiator is plugged and filled with air under slight pressure, and submerged to locate the leaks, just as an inner tube would be tested to locate a puncture. The tank in the sketch is designed to be used by two men, one at each end, and is five feet wide by eight feet long, so that the largest radiators may be tested.

The faucet shown in the center, with the hose attached, is used for washing out radiators, and when not being used for this purpose is left turned on slightly. An overflow for the tank is provided, as shown at the far left hand corner of the tank, so that there is a continuous flow of fresh water through the tank. This keeps the water free from acid, which is used in soldering, and which would tend to irritate the skin of the men working.

Before the radiator can be tested it is necessary to plug the various openings. A small plug or cork is sometimes used to cover the overflow pipe, or a piece of copper or brass may be sweat soldered to it to act as a temporary seal. It is very essential, however, to see that this is removed when the job is done, or the radiator may blow up when used on the car, due to accumulation of steam pressure, unable to escape.

The upper and lower water connections are usually stopped with an expansion type rubber plug. Such plugs may be made or purchased, the principle being that a piece of rubber, slightly smaller than the opening to be plugged is used. A bolt is put through the center of it, and washers used so that when the nut on the bolt is screwed down, the rubber will be squeezed out sideways so as to fit tightly in the opening. Wingnuts are often used for this purpose so that quick action will be possible.

The plug for the filler cap is usually a screw plug, often a regular filler cap, but made up with a tapered tubular extension for readily attaching the air hose. Four or five of these will take care of the radiators commonly received. On the tank shown in our shop there are two shelves, and on each shelf are shown two of these filler caps, fitted up for this purpose. With the inlet, outlet and overflow plugged, and with the filler neck fitted with one of these caps we are ready for testing.

Air pressure is required in our shop for two purposes, first

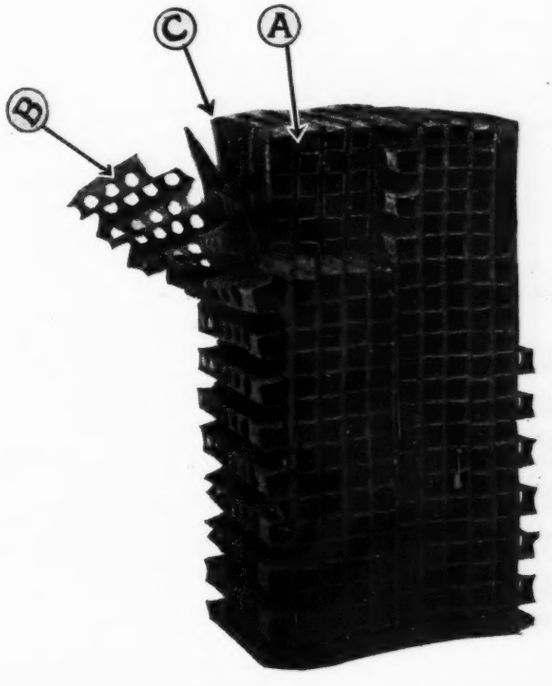


Fig. 7

A tubular radiator made to simulate honeycomb construction

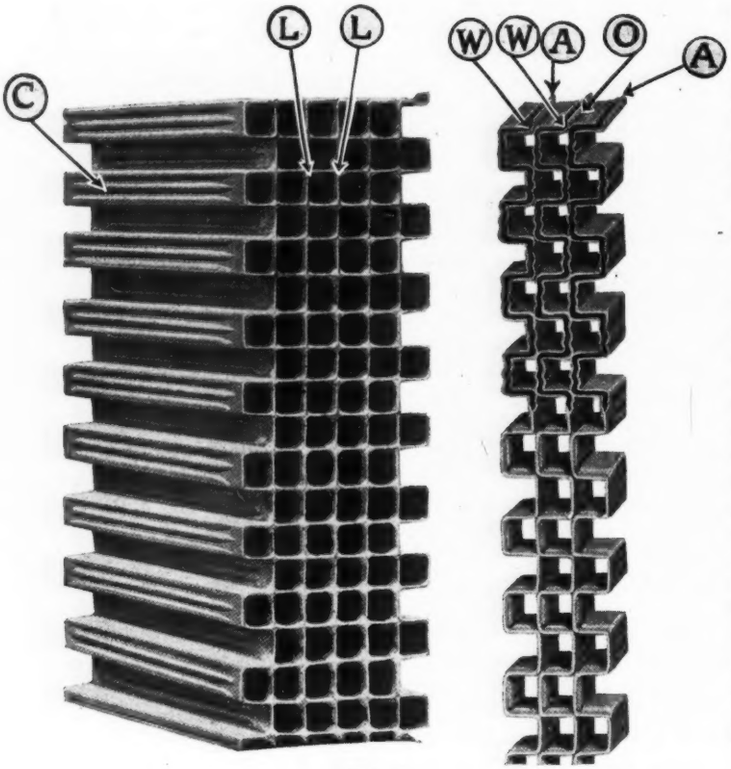


Fig. 8
Ribbon cellular type radiator in which tubes are bent to surround three sides of a square

for operation of the torch, which usually uses city gas, and second for testing for leaks. Although the average torch requires but from 2 to 12 pounds, more than this is often carried in the shop air line, correct adjustment of the torch air needle valve insuring proper operation. With a possible fifty pounds pressure in the air line it is also necessary to be careful in testing radiators, for new ones will stand eight or ten pounds while old ones are best tested with from three to five pounds.

Judgment Necessary

This is a point where experience counts, for the repairman must use good judgment, or an old radiator may be opened by the pressure, if too great. In our shop the air line comes up to the gage through a valve which is operated to allow just enough pressure from the line to enter the radiator. We now slip the air hose on the tapered tube of the filler cap, submerge the radiator, and turn the air valve a little at a time, until the gage reads about three or four pounds. Bubbles rising from the radiator should now make it possible to locate the largest leaks which should be repaired first.

In repairing these leaks we will make use of the torch and wire solder in most cases, using for a flux either muriatic acid, or cut acid, which is merely muriatic acid in which zinc has been dissolved until the solution will take no more.

Clean Surface Essential

Soldering of radiators, as well as other soldering depends first and foremost on getting the surfaces clean, and to accomplish this the flame from the torch and the straight acid are freely used. Scrapers of various shapes will also be found invaluable in getting the surface clean, and alternate scraping combined with applications of the acid and flame will be found effectual in cleaning the surface.

With the surface clean and bright the cut acid can be used, and wire solder can be used at the leak, being fed to the proper place by judicious application of the flame from the torch. On the same shelf with the filler caps will be seen two glass jars with brushes or swabs. These are the clear acid and the cut acid, above mentioned.

In working on the radiator, the padded edge of the tank is used to lay the radiator on when working on either side. When it is necessary to stand the radiator on edge, the box shown in the tank will serve very well, and when a diagonal position of the radiator is required, one corner can set in the box and the radiator will be held so that work is easily done.

Use of the Torch

Operation of the torch requires some practice and judgment, for if the flame is kept at any certain point too long, a hole may be burnt in the copper tube or water passage of the radiator. Adjustment of the flame for the work in question will also come with experience, for a sharp needle-like flame will be required for most work which must be done in narrow quarters. At other times a brush-like flame will be needed. Care must always be used not to have too concentrated a flame, so as to burn a hole, and on the other hand, if the flame is too broad, and the job at one place is done too slowly, it may be found that in repairing one leak another has been opened. This sometimes occurs even with the most experienced men, in repairing a radiator that has been frozen, so that it is weak all over. Under these circumstances, a leaky tube may be soldered, after which it will be found that the next one must be soldered, and so it will go until tubes nearly all the way across the radiator have required attention.

Repairs on Ford Radiators

The trouble most commonly encountered is in the seam of the tubes used in the Ford radiator construction, leaks in these being most commonly caused by freezing, which expands the tubes and opens the seams. Repairs of this kind involve prying the fins away from the part to be repaired. In some cases it may be necessary to pull out or cut away portions of the fins, but this should not be done unless absolutely necessary, as the fins are very important, in fact essential to the cooling action.

With the defective seam exposed, the tube should be closed or pinched together to its original size as nearly as possible, and either the torch or solder iron used to close the seam. As shown in the sketch of our repair shop, the furnace is used to keep the solder irons hot and ready for use.

After the leaks have been repaired, the fins should be straightened and resoldered to the tubes, and if any have been cut away, false fins should be used to provide cooling surface and also give the proper appearance. Such false fins can either be made or may be purchased by concerns dealing in radiator shop supplies.

Splicing a Tube

It sometimes happens that a tube has been so damaged that a portion of it cannot be used. Under these circumstances

Fig. 9
Ribbon cellular type radiator with zig-zag water passages

the defective part should be cut away and a splice made. Copper or brass tube can be purchased which is just the right size to slip into the regular tubes in the radiator. This is then soldered in place and the fins replaced.

Replacing Tubes

If any number of tubes are to be replaced, it is necessary to take off the top or bottom tank, but for one or two tubes this is not necessary. The old tube is removed by cutting in several pieces and using the torch to unsolder these pieces from the fins. The pliers are then used to pull the pieces out from the fins.

A three-eighths hole is now drilled in the bottom tank in line with the tube that is to be replaced, and the tube is inserted through this opening. The hole in the header to which the end of the tube will be soldered should be reamed clean with a 17/64-in. drill and the support bar should also be so reamed. After the new tube is in place, it should be soldered in at both ends and then a wire run through from the bottom to see that it is not stopped up with solder. A piece of brass or copper may then be soldered over the opening made for insertion of the tube.

It is quite necessary to solder this tube to all of the cooling fins, and this can be done by allowing flux to run down from one end of the tube to the other, following it by solder, started at the top, and caused to flow down past all the fins by proper use of the torch.

Plugging a Tube

It sometimes happens that a tube is damaged beyond repair, but the owner does not wish to pay to have the job done right. Under these circumstances it is possible to repair the trouble by cutting that tube out of circulation. This is done by cutting away a portion of the tube at each end, and filling the opening with solder and rounding it out, to give the appearance of a normal tube. On this job, considerable scraping and use of acid and torch will be required, to clean the metal on the inside of the tube so that it will take the solder.

Ford Radiator Parts Available

Work on Ford radiators is facilitated by the fact that practically all parts that may be needed are carried by authorized Ford service stations. This stock includes the filler neck, overflow pipe, side braces, inlet and outlet castings, splicing tubes and, of course, the hose and clamps used when installing the radiator on the car.

Recoring

It often happens, especially on radiators from high priced cars, that injuries are sustained which make repair to the core nearly out of the question. The use of certain anti-freeze solutions also so corrodes the core that its weakened condition makes it inadvisable to try to make repairs. Under these circumstances, the customer should be sold on the advisability of having a new core installed, the cost of which is considerably below the price of a new radiator.

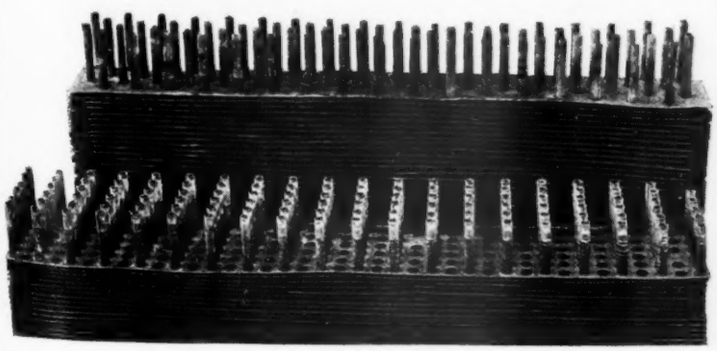


Fig. 10
Tubular radiator with round tubes

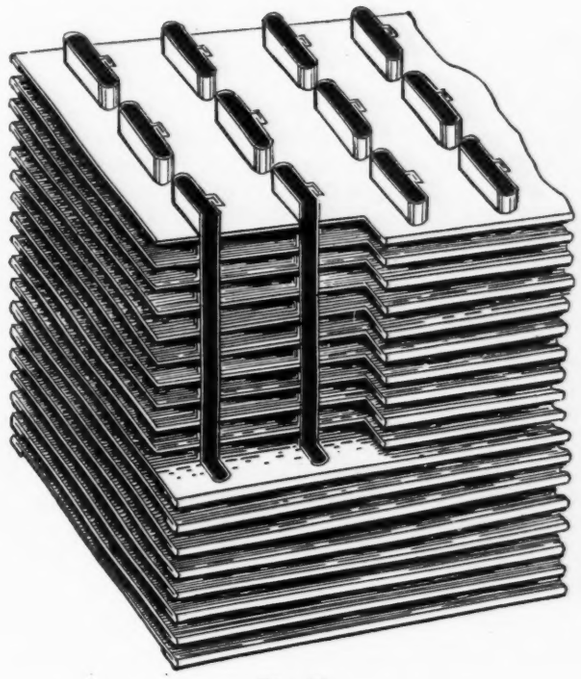


Fig. 11
Tubular radiator with oval tubes

As in the repair work, so in recoring, experience and judgment are required, and a knowledge of the construction of that particular radiator is a vital necessity. If the core that is to be replaced is out of shape, as would be the case if injured in an accident, it is quite essential to straighten it, so that measurements may be taken, and if in doubt, a template should be made. This can be done, where the core is of some special shape, a piece of cardboard being cut to the desired shape, so that the new core ordered will fit in the space available.

Finishing the Job

Repairing the leaks or installing a core is by no means the end of the job in a good shop, for a tag record is used, and a metal tag having the same number is attached to the radiator in some inconspicuous place, so that at any future date, if there is any question as to the work or as to when it was done, the metal tag will be available, and supply ready reference to the record of the job.

Furthermore, the sale of the job is not complete unless the customer is pleased, and as appearance is the only thing by which he can judge the work, it is desirable that the radiator be painted before being allowed to go out. Paint on the core has the effect of insulating against the radiation of heat, so it becomes necessary to use only such paint as is suitable for the purpose. This can be obtained from radiator supply houses. Applying by the spray method will also insure not only a thin coat with maximum conductivity, but also the best appearance.

As to Anti-Freeze Solutions

All roads lead to the radiator shop, for those who fail to use some anti-freeze solution are sure to wind up there, while those who use the wrong kind will also do so eventually. By the wrong kind we refer to chemical compounds which have a corrosive effect and weaken the metal of the core to such an extent that repairs are a waste of time. Authorities universally agree that the only safe course is to use denatured alcohol in the required proportions, and the radiator repair

shop that considers the good of its customers will advise its use only. The chart shown in Fig. 13 gives the proper proportions to use.

Advertising by the Hydrometer Test

Due to the fact that the alcohol evaporates faster than the water in the radiator, it is somewhat of a problem to tell how safe the solution is and how low a temperature it will stand. For this reason the shop that advertises free tests on radiator solution makes an investment in labor which will have to be charged to advertising, but which makes many friends for the establishment and brings in additional business when legitimate repairs are needed. At such a time a card bearing on one side the name of the repair shop, and on the other some helpful information as to the freeze point of various mixtures can be handed out, with the request that it be stuck under the cushion where it can be referred to in the event of trouble.

NOTE—MOTOR AGE wishes to gratefully acknowledge the assistance rendered by the following concerns, in making it possible to gather the material for the preceding article:

The Faber Schneider Radiator Co., Chicago.
Reliable Auto Radiator Works, Chicago.
Waser Auto Radiator Works, Chicago.
Kleber Sherman Mfg. Co., Chicago.
F. L. Curfman Mfg. Co., Maryville, Mo.

In addition to general points of information, the Waser Auto Radiator Works also provided the use of their shop for the purpose of making the sketch for Fig. 12. The F. L. Curfman Co., makers of radiator repair equipment, supplied cuts Nos. 5, 7, 8, 9, 10 and 11, from their book on radiator repairing.

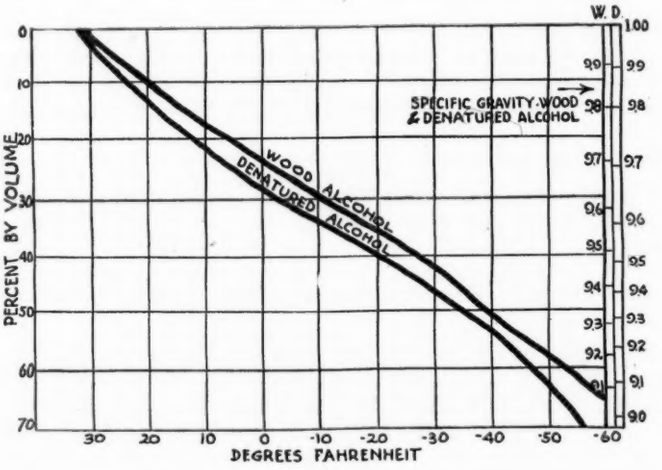


Fig. 13

Alcohol proportions required for safety at various temperatures

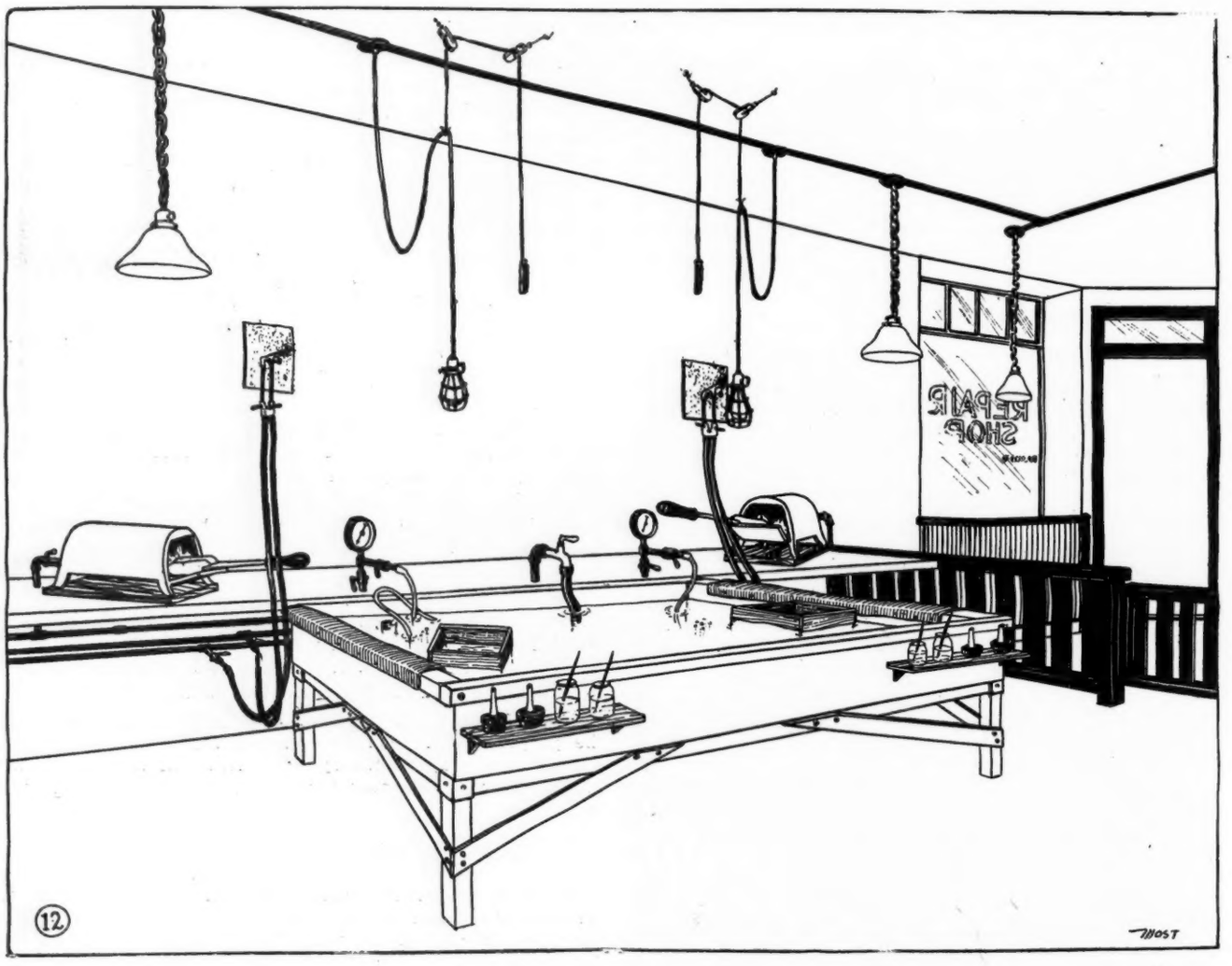


Fig. 12

Testing tank equipment as shown here will make a good impression on your customers, as well as making it possible to handle a large volume of work properly

Illustrated Winter Service Issue

Motor Age's Graphic Presentation *of the* Profitable Cold Weather Tasks

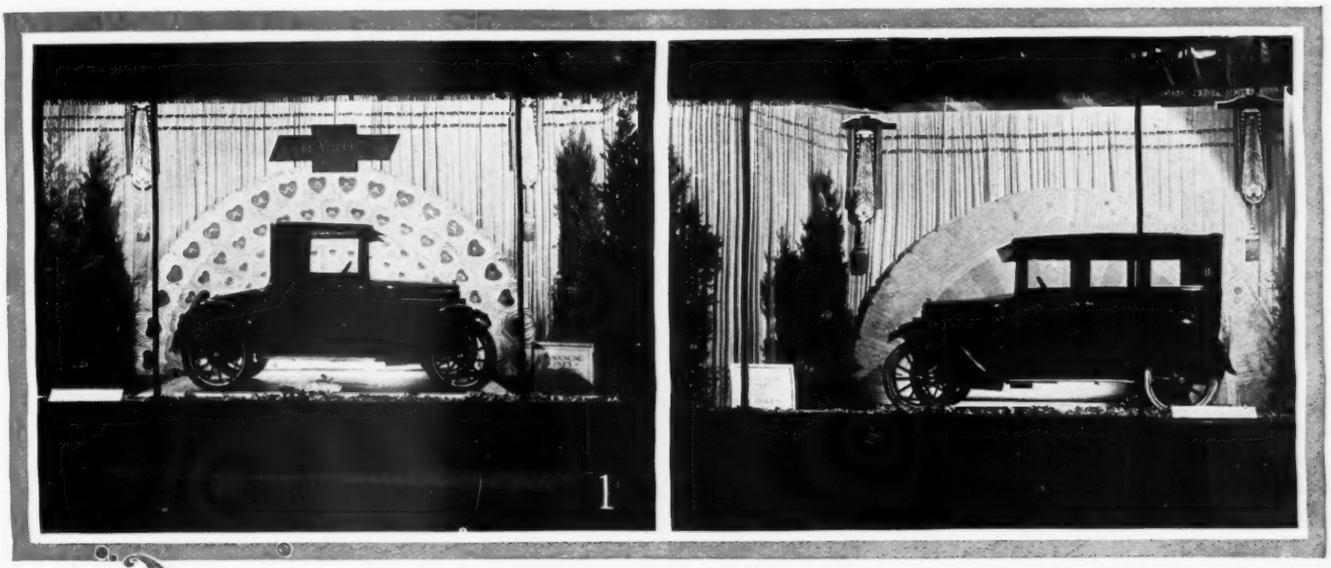
Snow Removal—The Big City's Winter Task

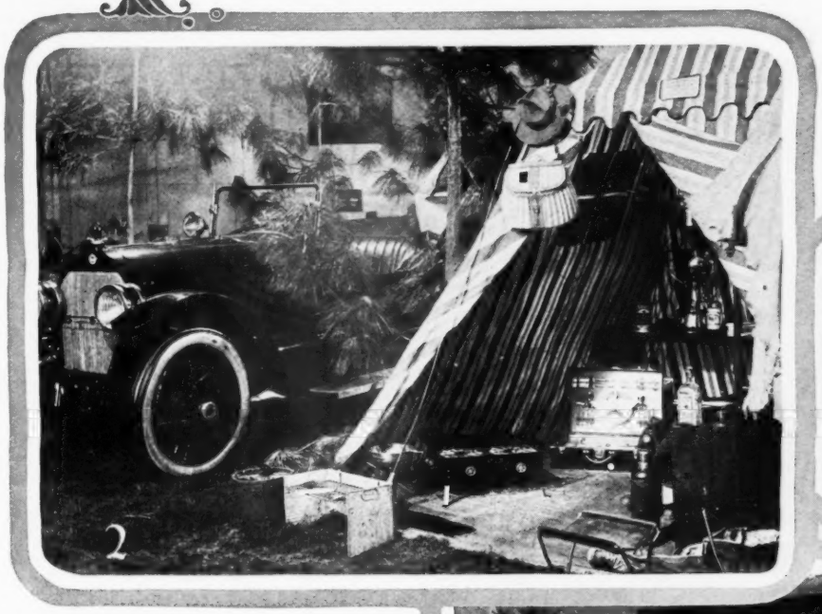
1—A typical scene in a Metropolitan city during a heavy snowfall. Motor cars and trucks must be kept running, hence the great gangs of workmen

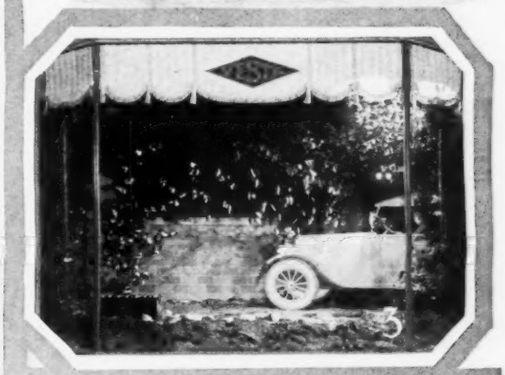
2—"Horse down," a common expression in winter. The motor car and truck have helped to reduce this sort of thing

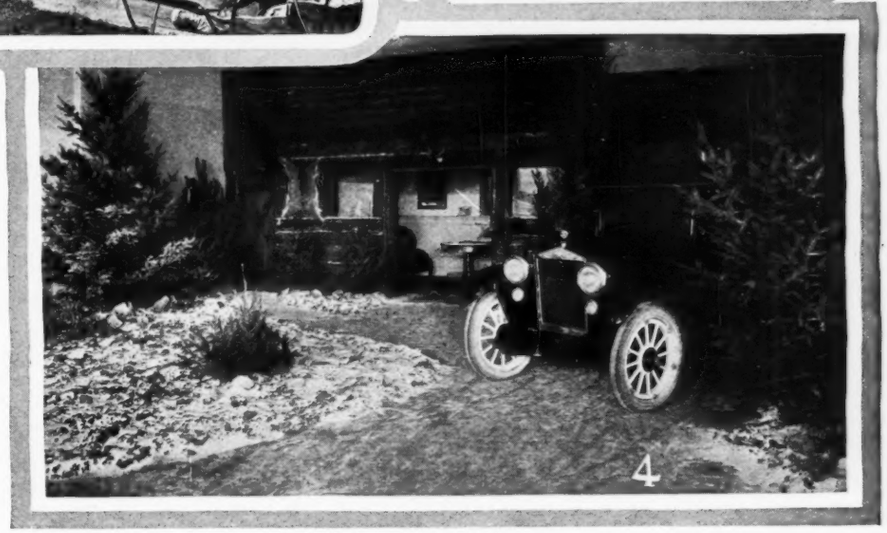
3—Loading up huge motor trucks to carry away the snow. It takes trucks to keep trucks going

As They Look Upon You Through Your Window









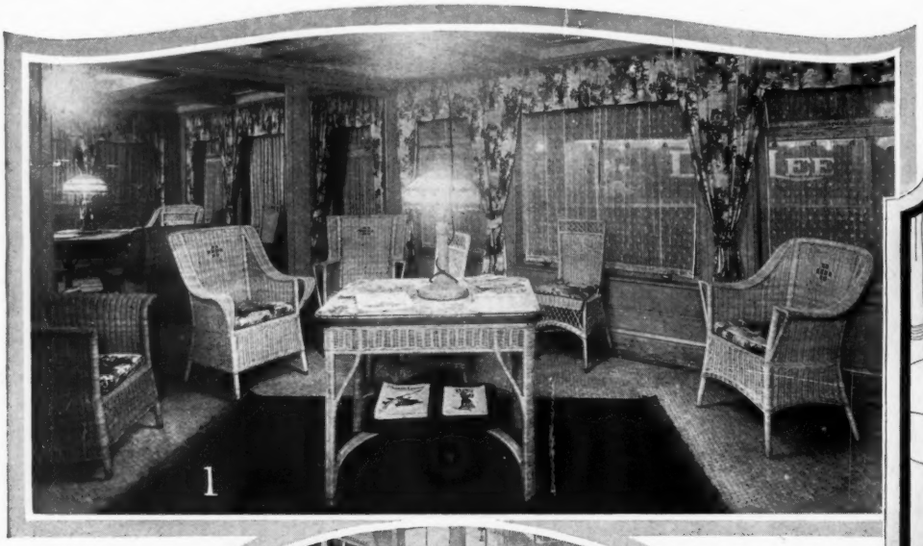
1—How the new Chevrolet line was presented in New York City

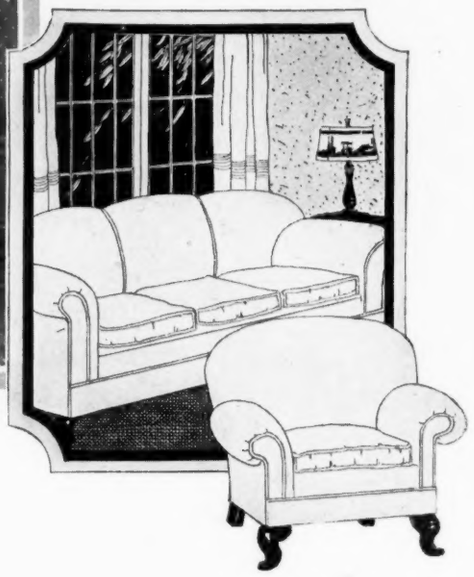
2—A window that appeals especially to the lover of out-door life

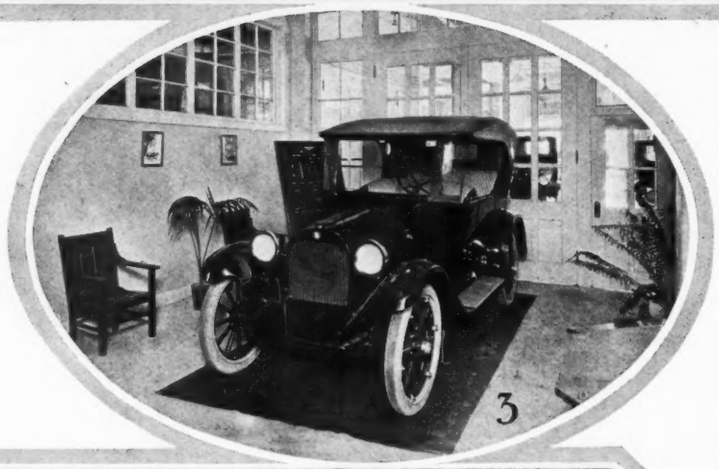
3—The feature of this window was the spotlight illuminating the battery

4—Converting the salesroom into a veritable outdoors

Making It Homelike for Your Customers and Friends







1—It is hard to think of engines or axles when you look at this pleasantly furnished rest room. At the right, a bit of suggestion to add class

3—One dealer puts the latest model in the rest room for customers' inspection

4—A small but daintily furnished rest room

5—Not elaborate, but warm, clean and pleasant

Salesrooms That Add Dignity to Your Business

1—The magnificent salesroom of Don Lee, Cadillac distributor in California even has a pipe organ in it

2—Besides the flowers and girl this salesroom has a radiophone

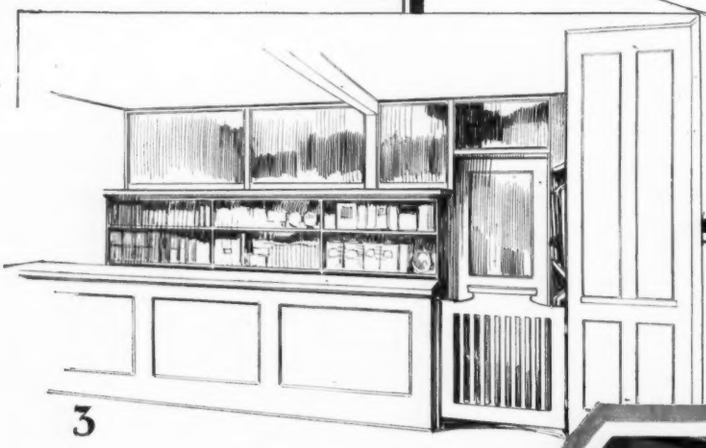
3—A small town salesroom with buff walls and mahogany trim

4—No, this is not an Egyptian temple, but a Pacific Coast dealer's salesroom

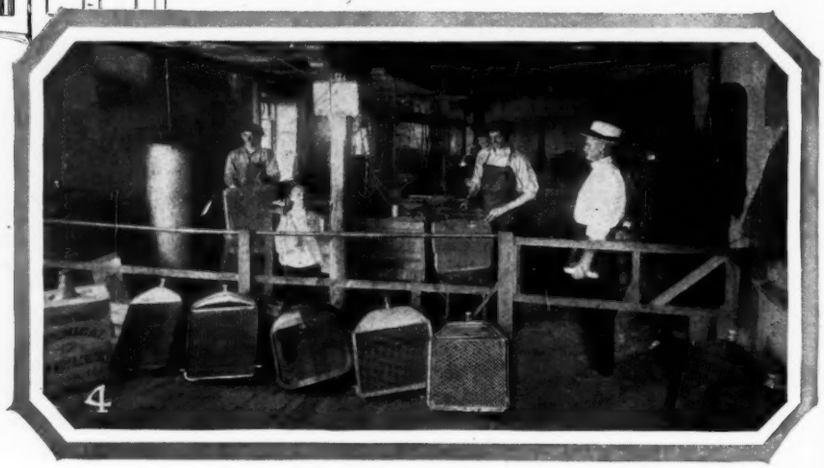
Winter—The Time to Make Needed Alterations

1—A case of too many signs and too little business. The general arrangement also is bad. A little time and money will improve this place one hundred per cent

2—The entrance, front and sign, shown in "1," might be rearranged like this. The alley offers a good chance for the car entrance. How much better the windows look, and the chance for display

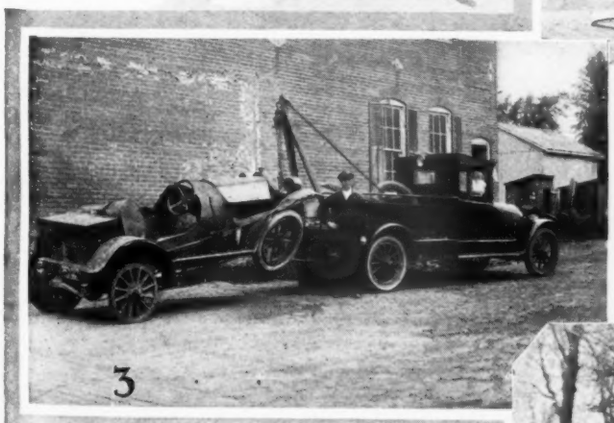


3—This is what we would do to the place shown in the lower illustration. It takes little material to make a partition like this and fit a show case



4—Imagine a customer coming into the door and immediately being greeted by this sight. The shop does excellent work, yes, but customers don't belong there

A Tow Car Helps to Keep the Shop Busy in Winter



1—Miles away from a big city but getting fixed up just the same

2—A completely equipped mobile repair shop

3—Because he had the tow car, he got the job of rebuilding the wrecked car

4—A good example of tow car, which will handle about every kind of road service

Personal Calls, Newspaper Advertising, the Telephone, Direct

YOUR CAR IN WINTER

If you are going to drive your car all winter, part of the time, or store it, there are certain things you ought to know about its maintenance.

First. If You Are Going to Drive All Winter—

You must make sure your engine is operating at its maximum efficiency, because the engine will be called upon to work under adverse conditions brought about by sudden atmospheric changes and temperatures. Electrical systems, especially the storage battery, are not quite so efficient in cold weather and the generator charging rate, etc., must be regulated accordingly. Carburetion problems are more acute. Brakes must be lined properly and adjusted to avoid skids on icy streets. The driver must have vision when there is sleet, snow and rain. Cooling systems must be kept from freezing up. In short, a car must be made ready, preparatory to facing the rigors of winter.

Second. If You Are Going to Drive Part of the Time—

Some car owners drive only part of the time in cold weather. Their cars must be maintained just the same as those who drive all winter. Cars that are used but part of the time must be protected against freezing and it should not be necessary for the owner to have to spend several hours getting the car ready for a few hours' drive. The car should preferably be stored in a warm place, so that it is instantly available and where it can have regular attention regarding the battery, tires, etc.

Third. If You Are Going to Store Your Car—

A car, unless properly cared for, is apt to deteriorate as much when not in use as when driven. There is a right and wrong way of storing a car. We would rather see our customers drive their cars all winter, but many are not able to stand the severity of cold weather driving and for such it is necessary that provision be made to care for their cars while they are in storage.

NOW—

Whichever one of these three things above you are planning to do, we can help you. Our facilities makes it just as easy for us to keep your car in mechanical condition as to store it for a few months. Of, if you want to drive occasionally, leave your car with us. We'll have a man bring it to your home or office. Come over and see how we do it.

RUNWELL MOTOR SALES CO.
108 West Main St.
Telephone 230

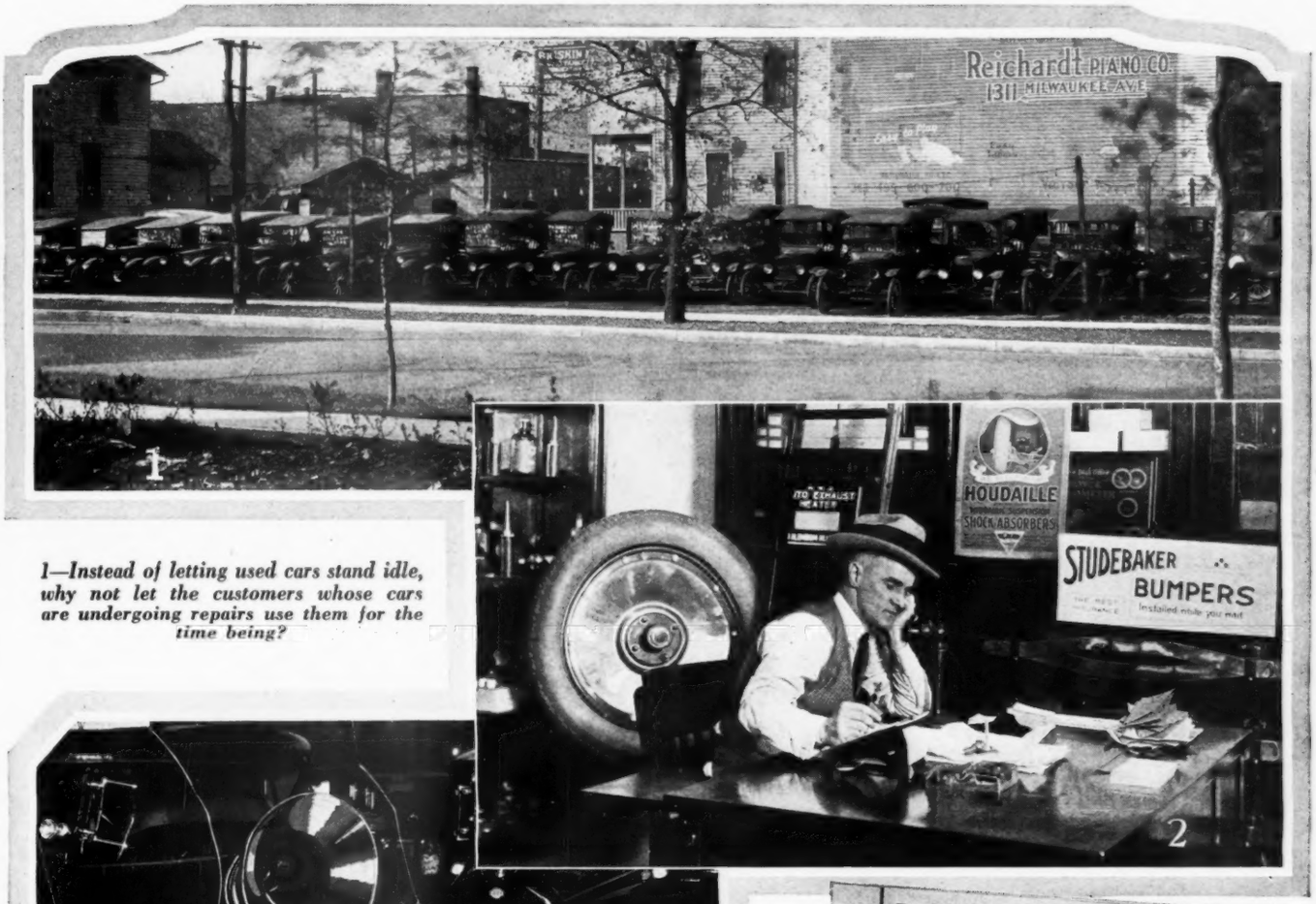
2

1—Drive one of your closed models to the prospect's house on a chilly day or night. Take him anywhere he wishes to go and sell him on closed car necessity and comfort

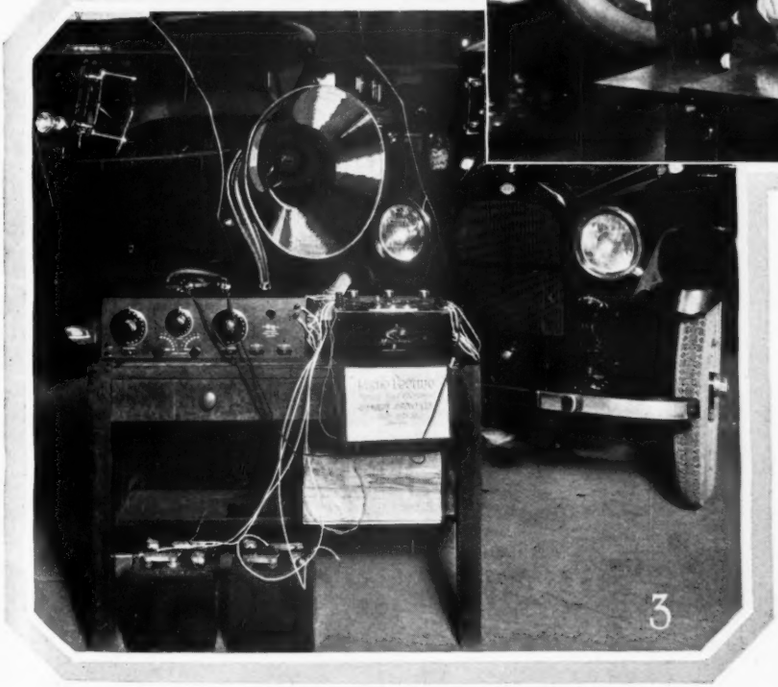
2—A suggested newspaper advertisement, which can be used by most small town dealers. Your printer has this kind of type and he can follow the layout almost to the letter

3—A window which has obtained hundreds of dollars' worth of business by its beautiful makeup and variety of merchandise

by Mail and the Radiophone All Help to Get Winter Business



1—Instead of letting used cars stand idle, why not let the customers whose cars are undergoing repairs use them for the time being?



2—The telephone is one of the most economical and quickest ways of getting winter business

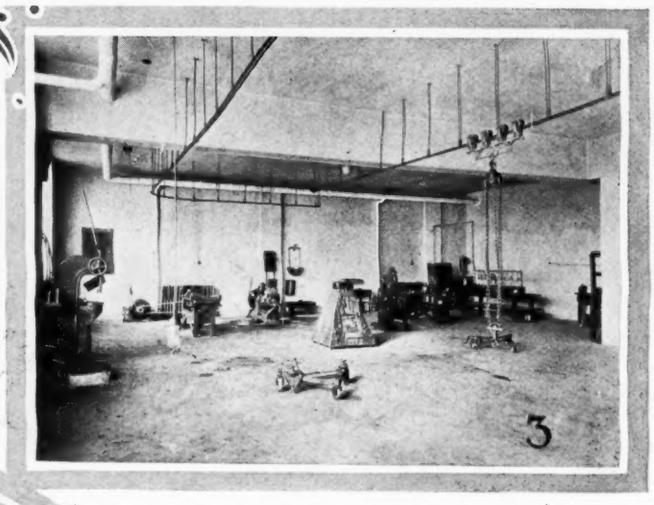
3—The small town dealer can get a crowd into his place with a radiophone. It offers a chance to see your new models

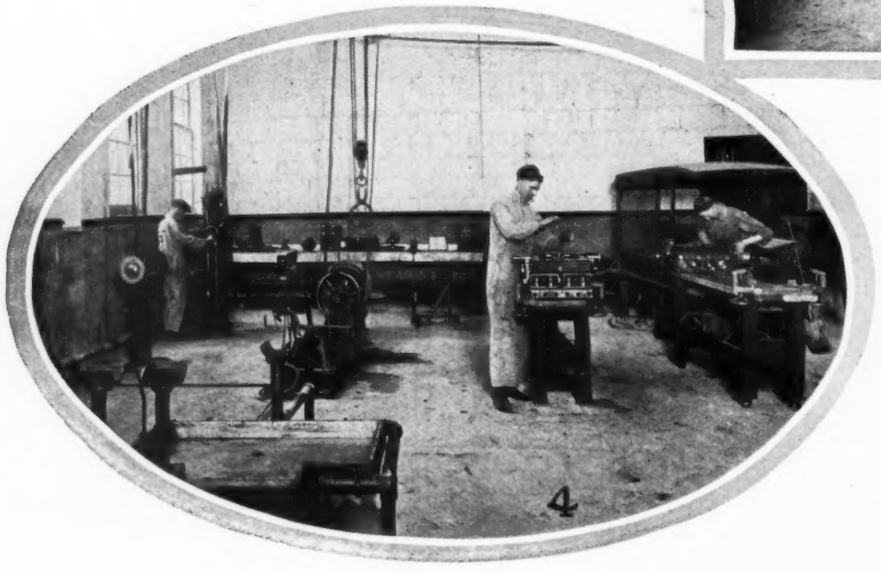
4—A business-getter sent out by a prominent St. Louis dealer

Breaking-In Your Motor
DRIVEN by electric power and immersed in oil, new bearings are "broken-in" to function perfectly with this modern device---the Running-In Machine.
No stiff motors, no scoring of cylinders, no lost power after overhauling here, where interest in your successful use of your Buick is paramount.
VESPER-BUICK AUTO CO.
MAINTENANCE DIVISION
WEST PINE AT VANDEVENTER SAINT LOUIS
Our Mechanics are Buick Craftsmen. They do their work thoroughly and expeditiously; and their work is guaranteed.

Getting the Best Possible Repair Work From a Shop Depends

1—The excellent shop of the Detroit Cadillac Co. Note the absence of belts and line shafting. Each machine is motor driven. What a blessing if every shop were as clean



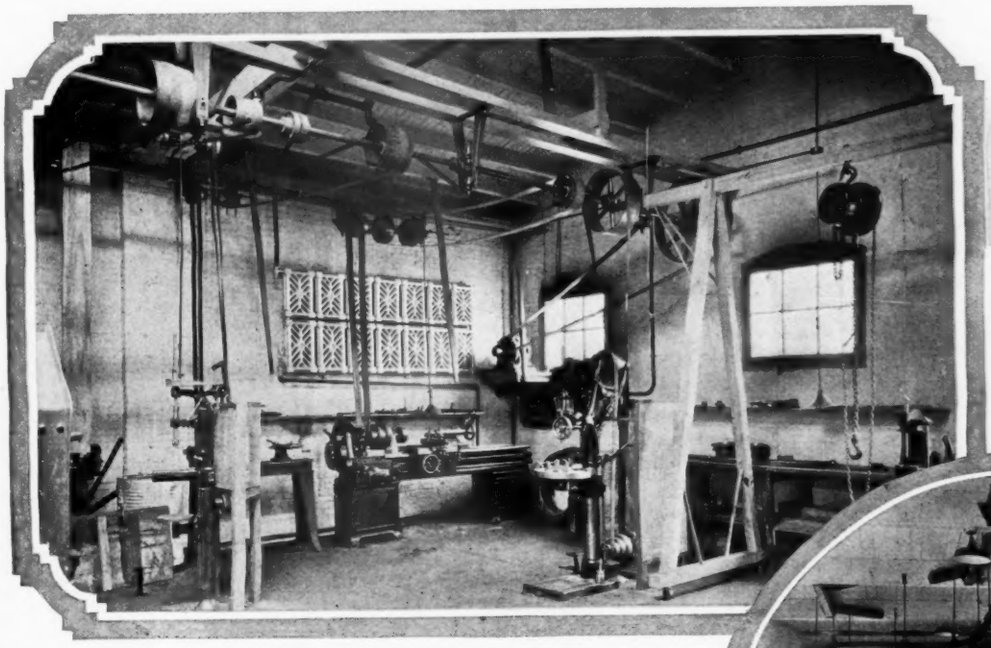


2—Plenty of light here, a good bench and good arrangement of overhead carrier equipment

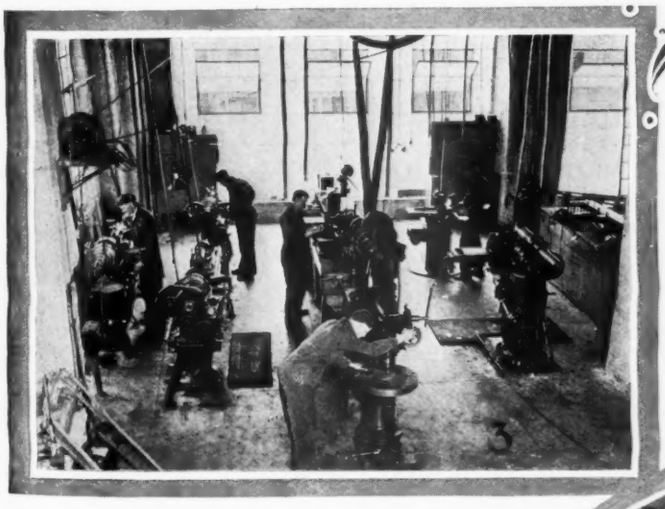
3—Here is a picture taken in a small town shop, somewhere out in Iowa. It shows the small shop can be just as neat and clean as its big brother

4—Machine tool equipment is one of the finest assets of a shop. It makes the shop independent of the big city

Largely Upon Its Careful Planning and Fitting Out



1—The average type of shop, the machinery of which is driven by line shafting from an electric motor

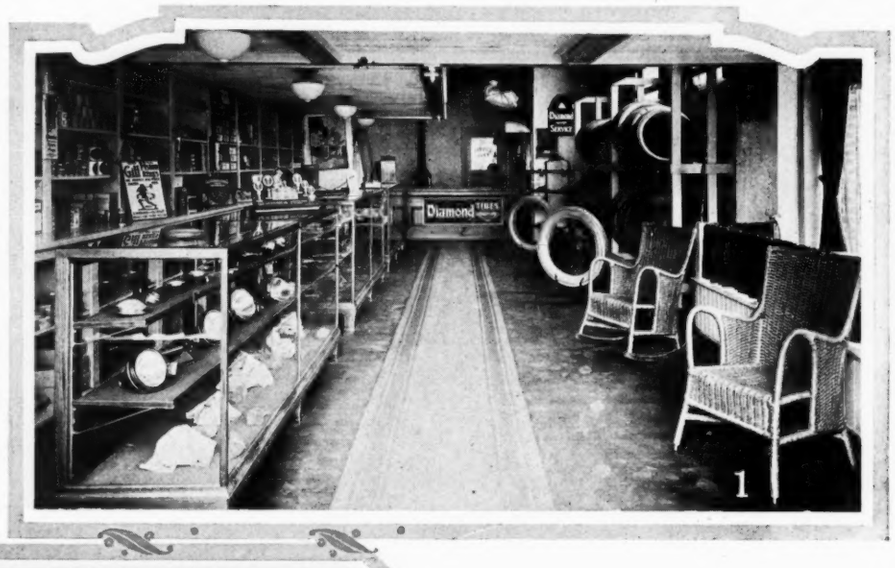


2—What a job it would be to lift out this engine if they didn't have the chain falls and overhead carrier

3—There is even a shaper in this shop. This firm does a general repair business, hence all the equipment

4—Many of the small town shops are laid out in this manner. Full advantage is taken of the light. Note that even the small shop can use an overhead carrier

Boosting Tire and Accessory Sales by Good Display



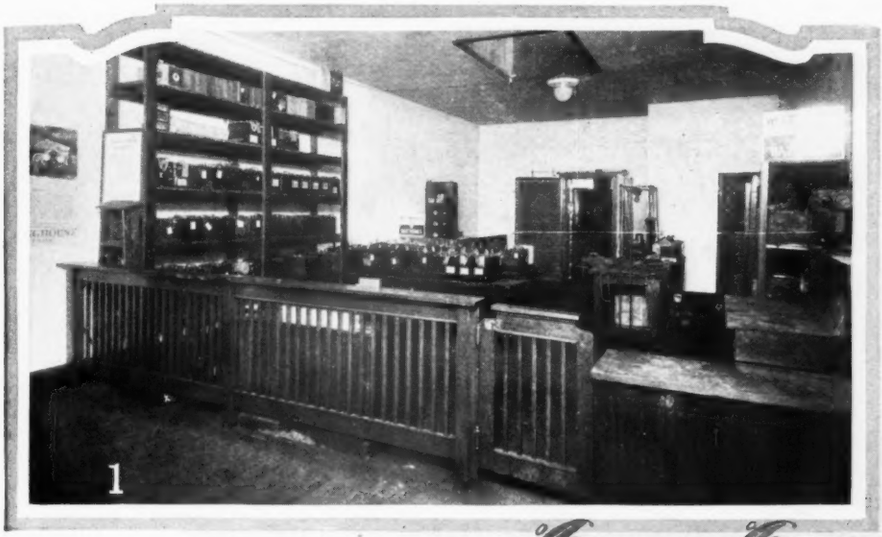
1—It would be difficult to imagine a more orderly small town tire and accessory business than this one. How often do you see wicker chairs in a tire store?

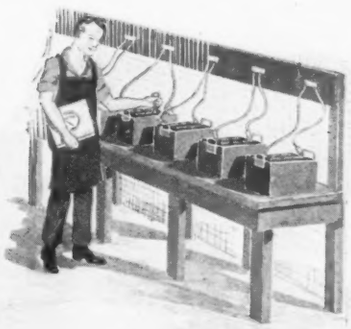
2—This picture was taken in a large city tire and accessory store, but the neatness of the showcase and stock is something to be borne in mind by all

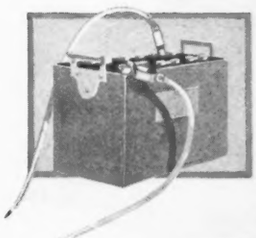
3—A little different way of fitting out an accessory department. In the window are large pieces of apparatus. The buiding is wedge shaped

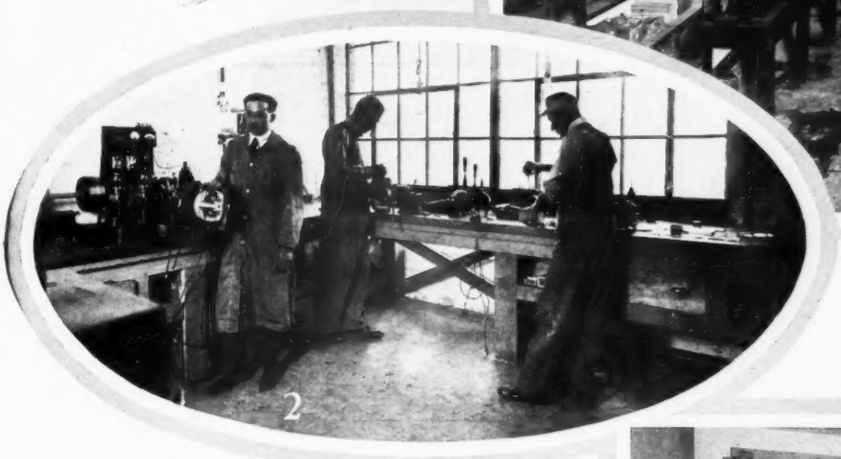
4—This small town dealer used to keep his new tires piled on top of each other. Now he has a far more business-like rack

Automotive Electrical Maintenance—A Great Kindred Industry

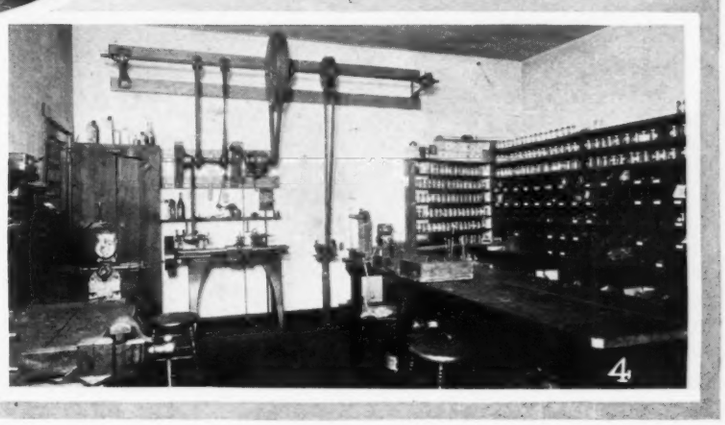








3—Even a battery room can be clean and attractive. Note the excellent layout in this establishment

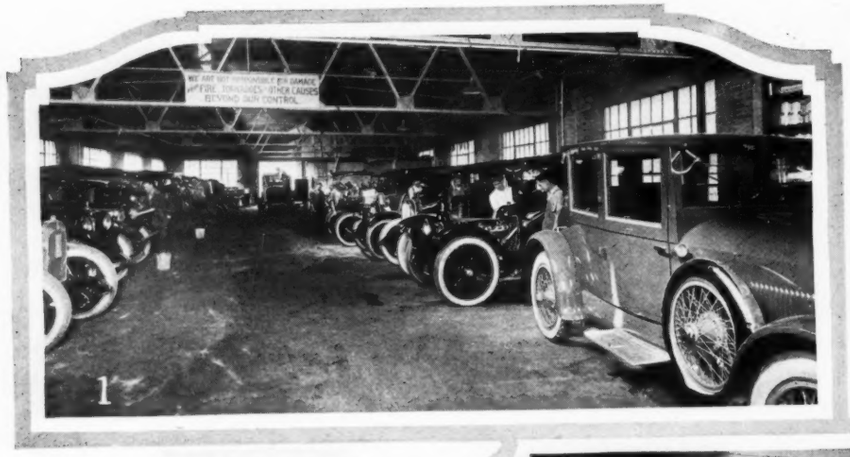


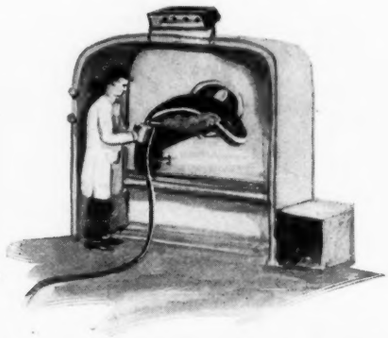
1—The neat battery room of the Evanston Electric Service, Inc., Evanston, Ill.

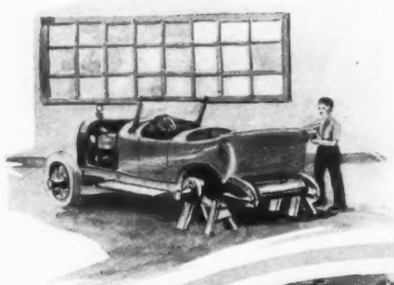
2—Like the highly specialized mechanic for engines, we have trained mechanics for the electrical systems

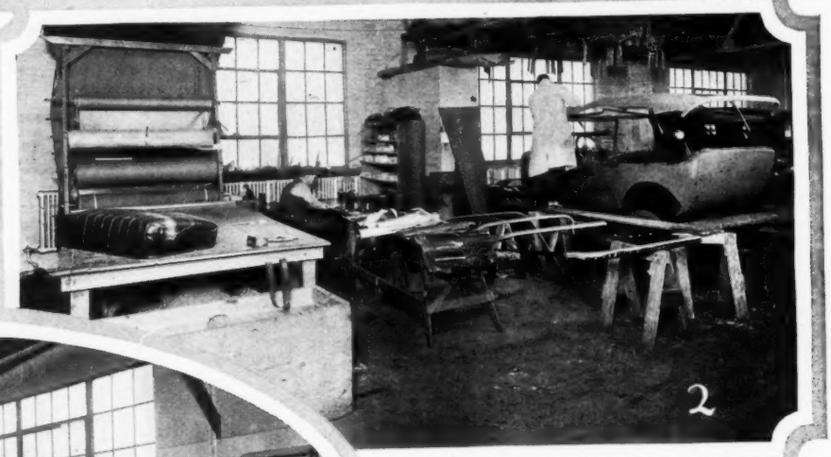
4—Talk about a neat little shop. It is that of the Evanston Electric Service, Inc.

Painting—The Newer Avenue to Profitable Maintenance



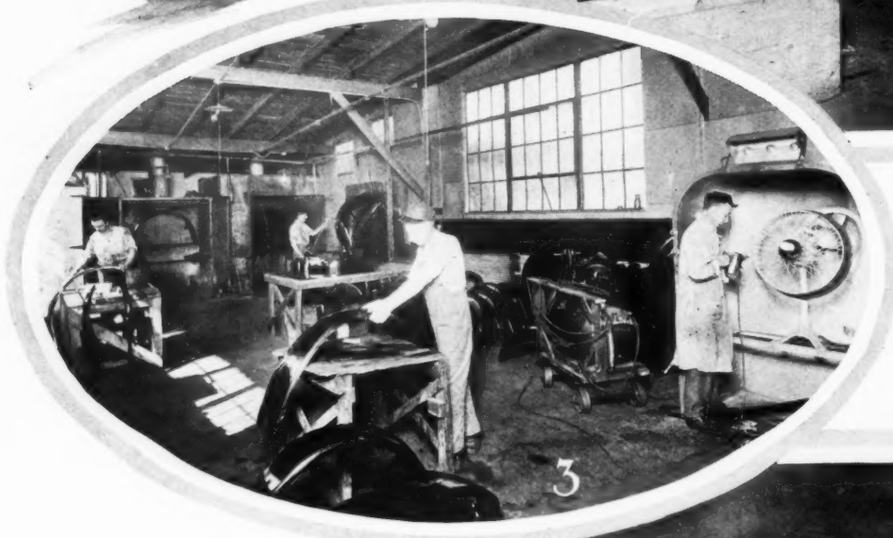






1—A well lighted room for the refinishing of cars. All but the finishing coats of varnish can be applied in this room

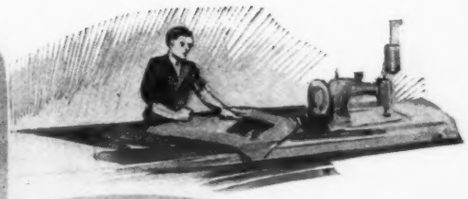
2—Maintenance work on cars is not all engines and axles. The body and top must come in for their share sooner or later. Here is a trim department

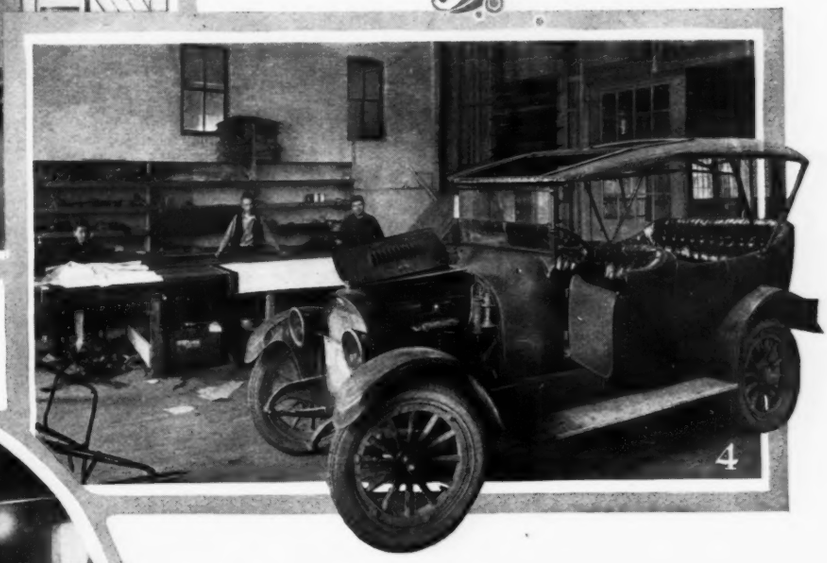


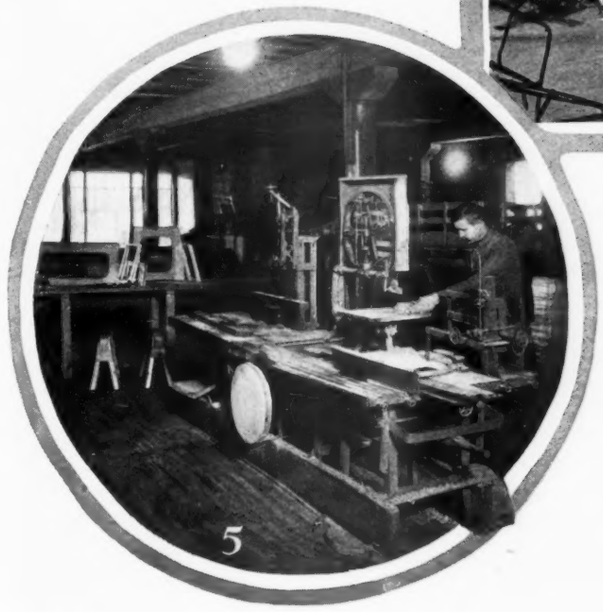
3—An enameling room, showing the ovens, drain board and spraying equipment for wire wheels

4—Dust-proof finishing room, the air in which is filtered before it enters. These pictures were taken in the shop of the Louisville Auto Painting and Trimming Co.

Sell Them a New Top, Seat Covers or Upholstery







1—The building of permanent type tops is proving to be a profitable business. The work can be done while the chassis is undergoing other repair work

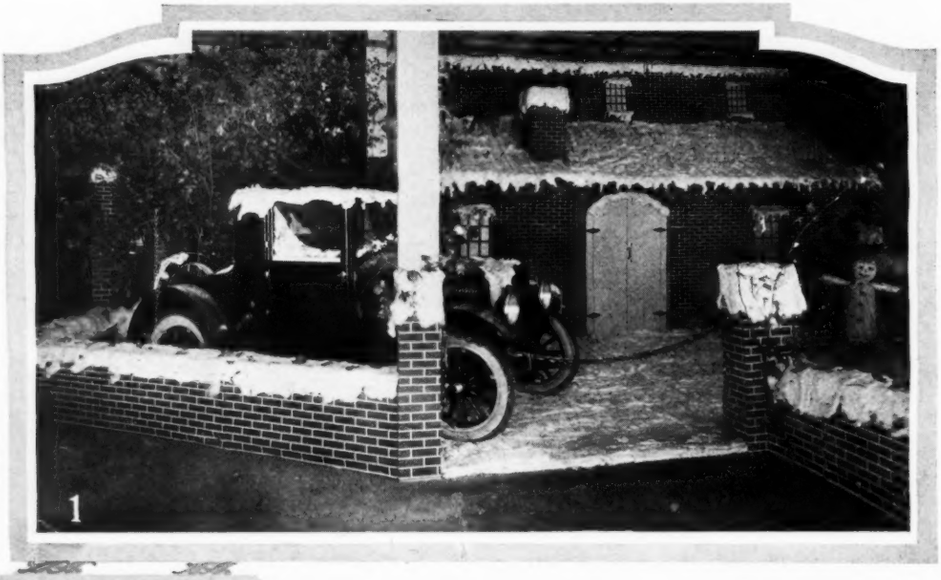
2—Where the fabric for the tops is cut out and sewed

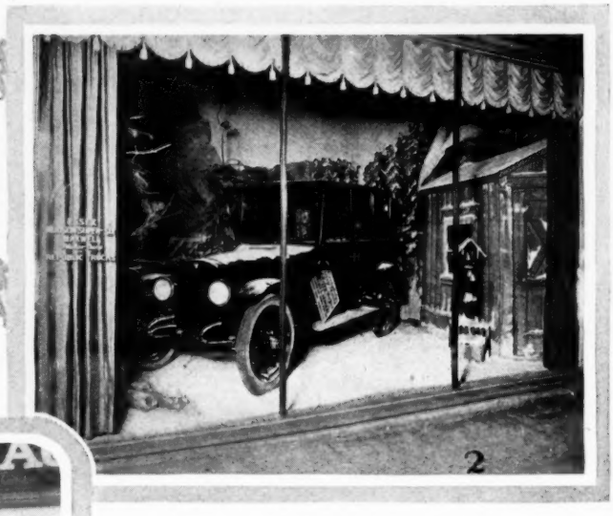
3—A trim department does not require very much room, so far as actual equipment is concerned

4—Here is a car of more or less ancient vintage being dressed up with a new top

5—Some maintenance departments go so far as to install wood working machinery for making door frames, dash boards, sills and similar parts

Giving a Thought or Two to the Christmas Patron





1—All you need here is Santa Claus himself, acting as salesman

2—What one dealer did to attract Christmas trade. A snow window always looks bright and cheerful

3—Another suggestion for a holiday window. Though a car is not shown, you feel like going inside and talking anyway

4—And here we have a car coming right out of the Christmas box, which stands under, or alongside we should say, the tree with the other gifts

Steering, From the Maintenance Viewpoint

Theory of Steering as Applied to Motor Vehicles. Equipment List, Lubrication and Adjustment

By PAUL DUMAS

ONLY a few of the many factors concerning the design of a steering system are of any practical value to the personnel of the maintenance division of the industry. The maintenance man is most interested in having the information that will enable him to properly maintain the steering system of the car he services. He wants to know how and where adjustments are made when necessary, due to natural wear or to neglect. The remedies for hard steering and wheel wobble, or "shimmying," are of greater value to him than the knowledge of the stress imposed on a worm tooth section of given dimensions.

Incidentally it might be mentioned that the exact causes of wheel wobble have not been definitely solved as yet, although there is a large list of possible remedies. It is the purpose of this article to outline the fundamentals of the system of steering as applied to automobiles today, to classify the types of gear used on cars, to supply instructions for adjusting these gears, and to present a list of theories and practices incident to the cause and cure of wheel wobble, or "shimmying."

To get a clear idea of what the steering system must accomplish, in order to permit maneuverability of the motor car, let us consider the steering system of the forerunner of the automobile, the horse-drawn carriage. The carriage was steered by having its front axle pivoted at the center, the power being applied from an outside source, the horse. The wheels being then rigidly attached to the axle were held on the radius of the turning arc and compensation for the difference in speed of the outer and inner wheel was provided by the considerable slipping of one wheel when turning.

The slow speed of the horse-drawn vehicle permits of such construction without any great uncertainty of steering, although the driver was forced to learn that the arc of turning, unless turning was done at very low speeds, should be on a radius of about twice the wheelbase length of the carriage. With the power applied from the rear, as in the conventional motor car, such a system of steering would be entirely inadequate. Imagine trying to push a horse carriage from the rear when the front wheels are at the angle, with the rear wheels, required to make a short turn. To do so would require sufficient power to make one of the wheels slip sideways.

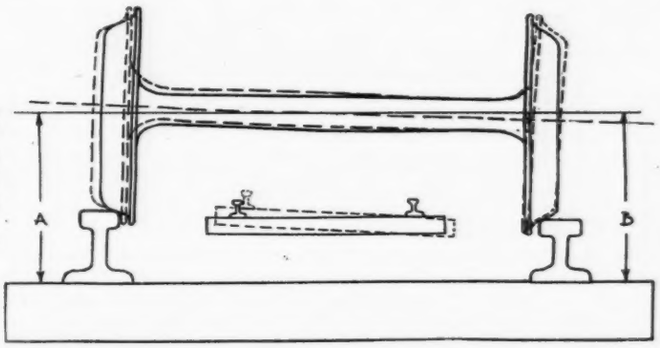


Fig. 1
Differential effect on steering of railroad car is secured by utilizing principle of the cone. The outside wheel rides on its largest diameter when rounding a curve

The side slip caused by the turning of two front wheels is eliminated in the railroad truck wheels by constructing each wheel in the shape of a double cone. The largest diameter of the cone is called the flange of the wheel, and the railroad wheels when rounding a curve assume different positions in relation with the rails than when going straight ahead. The outer wheel, when rounding a curve, is forced by centrifugal force to ride on its largest diameter, which is near the flange, the inner wheel being rigidly attached to the other end of the solid axle, by the same force is compelled to ride on its smallest diameter. At the moment of turning or rounding the curve the wheels tend to describe concentric arcs on account of the difference of diameter of the wheels at the time. In actual service the cone effect of the railroad wheels is partially destroyed through wear produced by friction, so that the compensating effect is less, and to assist these conditions the angular distance between the rails is altered by elevating the outer rail, or banking, as it is sometimes called. This differential action of the variable diameter car wheels is shown in Fig. 1.

The automobile operates under widely different conditions of roadbed than the railroad car and cannot practicably be equipped with wheels of variable diameter, and for structural and mechanical reasons the center pivoted axle of the carriage is undesirable. The necessity for better steering, even in early models of the automobile, was responsible for the adoption of the pivoted or Ackerman axles, which were invented long before the inception of the horseless carriage. The Ackerman axle, with many modifications, is the standard construction on all motor cars at the present time. The modifications were almost entirely constructional, the basic principle in each case being retained.

A description of the pivoted axle is unnecessary except in so far as to show how the front wheels are made to describe concentric arcs or arcs tangential to a common center. In order to get this effect it is apparent that some arrangement must be made for varying the angles of the two front wheels in relation to the axle proper. It was evident from reviewing the steering action of the railroad car and the horse-drawn carriage that when the vehicle's position is changed from a straight-ahead position to a turn or curve that the wheel moving on the inner track or smaller arc must assume a greater angle with the axle proper than the outer wheel, which moves on the larger of the two concentric arcs. In short, the inner wheel must be turned farther in the direction of turning in relation to the axle than the outer wheel. To obtain the

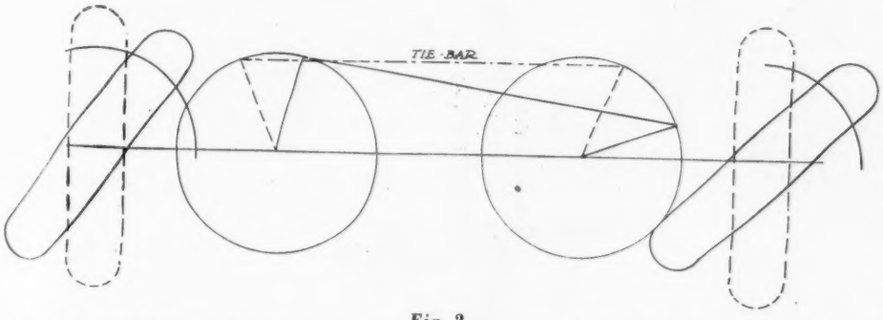


Fig. 2
The full lines indicate the relative positions of the front wheels when the arms are placed at an angle greater than 90 degrees to the axle. It is necessary that the inner wheel travel a greater angular distance in order to prevent skidding

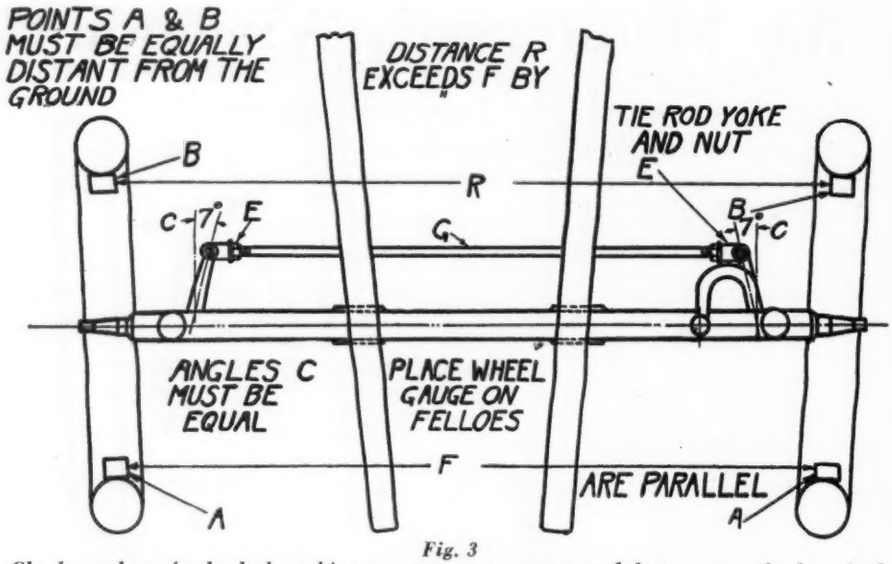


Fig. 3

Check camber of wheels by taking measurements at top and bottom on wheels. Angle mounting of the steering arm can be checked as per dimensions B and C

variation in angle of the front wheels necessary to make a turn with the minimum of slippage, the steering arms, or spindle arms, as they are sometimes called, must be so mounted or attached that their ends are not at right angles with the axle member. The usual practice is to have the steering arms pointed inward or outward, depending on the location of the steering crossbar and drag link.

Assume that the steering arms have the relative position with the axle as shown in Fig. 3, when the wheels are in the straight-ahead position; now when the driver desires to change the direction of travel, the outer arm will move toward a position where it will be nearer at right angle with the axle, at the same time the cross or connecting rod, being connected with the inner arm, also will cause it to move away from the right angle position. The end of the cross or connecting rod will, in widening the angle, describe an arc, this passing through a greater distance than will the outer or opposite arm. The position that the wheels will assure in relation to each other is apparent by reference to the solid lines in Fig. 2.

The effect of mounting the steering arms both at right angles to the axle is shown graphically on the same figure in the dotted lines. The outer wheel in that case would remain parallel with the inner wheel and excessive slippage or skidding would result.

Although the mounting of the steering arms as described does not provide absolute compensation for the change of arcs when the wheels are at the extremely long or extremely short run positions, it offers a compromise that adequately compensates for the curves of radius usually encountered, and the parallelism of the wheels at the smaller or larger angles is not affected enough to cause dangerous skidding, although of course some slippage must take place.

A typical mounting of the steering arm is shown in Fig. 3. Often the steering arms become bent or distorted from collision or other accident, with the result that very erratic steering ensues. Sometimes the service man attempts to correct a bent steering arm by adjusting the transverse connecting or cross rod. This will not cure the tendency of the car to skid when turned in a certain direction, nor will it correct the diminished turning angle brought about by the bent arm.

The straightness of a steering arm can be determined by checking the angle of each arm with relation to the axle when wheels are in the straight-ahead position with the recommended amount of toe-in. The exact angle with relation to the front axle differs with the various axle manufacturers, but satisfactory results from the standpoint of maintenance are obtained when both arms have the same angle relative to the axle, though the angle vary slightly from the maker's recommendation. It is good practice to check the steering arms of any vehicle that has met with damage due to collision or other accident.

Widely Used Types of Steering Gears

Steering systems as applied to all cars and trucks are fundamentally the same and differ only in the method employed to actuate the steering arms by which the wheels are turned. The transverse or cross steering system is used most frequently on commercial vehicles and also on the Ford and a few other passenger cars. The usual system as applied to the great majority of passenger cars is known as the fore and aft system, wherein the steering post ball arm is connected to the connecting rod by means of a drag link mounted parallel with the wheelbase or longest dimension of the chassis. The different types of steering post construction in common use today are classified as follows:

The worm type (which includes the worm and wheel and the worm and sector).

The screw and nut type (which includes the solid nut and the split nut types).

The cam type (a recent development and used at present in only limited numbers).

The production of worm type steering gears is divided between four companies, the Gemmer, Warner, C. A. S. and Ditweiler.

Gemmer gears are of the worm and wheel type and are listed according to information supplied by the car manufacturers as factory equipment on the following cars:

Anderson	Essex
Biddle	Ferris
Cole	Handley-Knight
Columbia	Hatfield
Comet	Hanson
Cunningham	Holmes
Daniels	Hudson
Elcar	Jordan

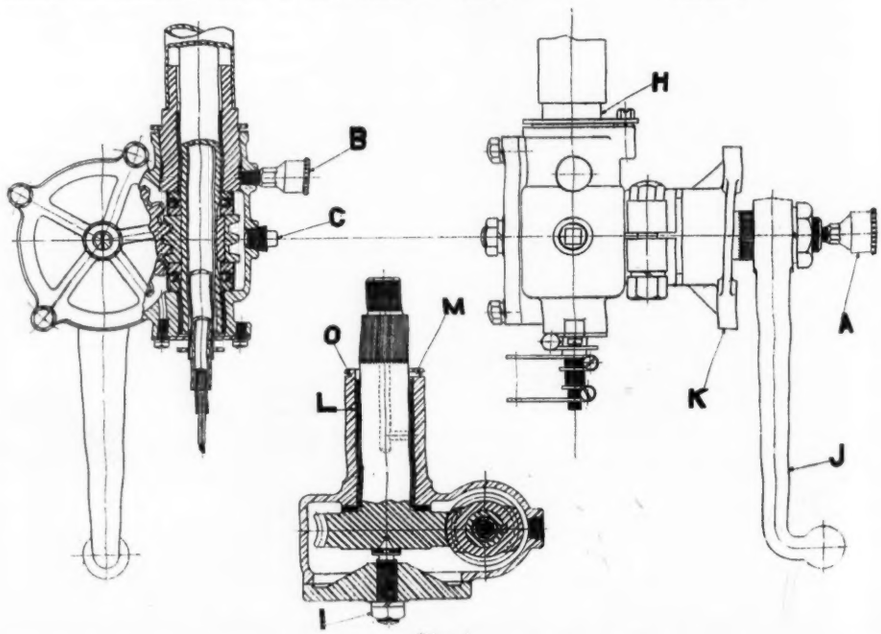


Fig. 4

This model is similar to the model K except that end play in the worm shaft is taken up by means of a thrust screw adjustment

Kurtz	Ogren
Leach	Peerless
Liberty	Revere
Mercer	Rickenbacker
Merit	Rock Falls
Meteor	Stanwood
Moon	Stutz
Murray Mac	Velie
Nash	Westcott

Trucks using Gemmer gears are as follows:

Atterbury—Models 20R, 7CX, 7DX, 8E.
Brockway—Sk, K5, R4, T4.
Chicago—C1½ C2½, CB½, D5.
Day Elder—A, B, C, D, E, F.
Denby—33, 134, 25.
Diamond T—O3, fs, U. K, E1.
Federal—SD, TE, UE, WE, X2.
Hal-Fur—D, B, F.
Hall—2½, 3½, 5, 7.
King Zeitler—1, 1½, 2½, 3½, 6.
Kelly-Springfield—K34, K38.
Larabee—K2, J4.
Netco—DK, HL.
Niles—E.
Rowe—H. S. W.
Selden—2½A, 3½A, 5A.
Standard—66, 5K.
Triangle—AA, A, C, D.
Wilcox Truck.
Wolverine—J1, J1½.

Two models are listed, K and M, which are illustrated in Figs. 4 and 5.

Adjustment—Model "M"

The up and down play of the worm is adjusted by means of the adjusting nut "H," Fig. 4.

The end play of the worm shaft is taken out by means of the adjusting screw "I."

Should the teeth of the worm gear show wear after long service, the ball arm "J" may be removed and the steering wheel turned out until the worm wheel shaft has revolved through 90 degrees.

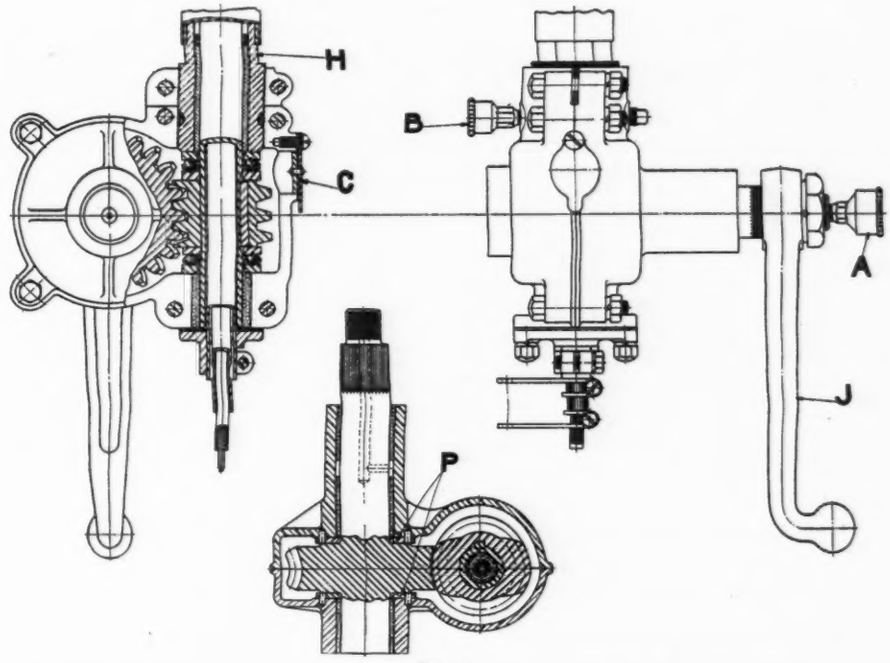


Fig. 5
The model M utilizes thin thrust washers which are removable and replaceable by thicker ones to compensate for end play in the worm shaft

This brings new teeth into contact and the ball arm may then be assembled in the new position.

Additional adjustment to secure better mesh between the worm and worm wheel is provided by the eccentric bushing "L." To operate the eccentric adjustment, proceed as follows:

Remove steering post from chassis and take mounting bracket "K" off steering gear. Remove spring lock wire "O" and pull out pin "M" which is in one of the eight slots in the end of the bushing; next adjust the bushing to the desired gear tooth mesh, replace pin "M" and reassemble lock wire "O."

Lubrication

Shaft lubricator "A," medium heavy dope, weekly.

Column lubricator "B," medium heavy dope, weekly.

Housing plug "C," medium heavy dope, fill housing every three months.

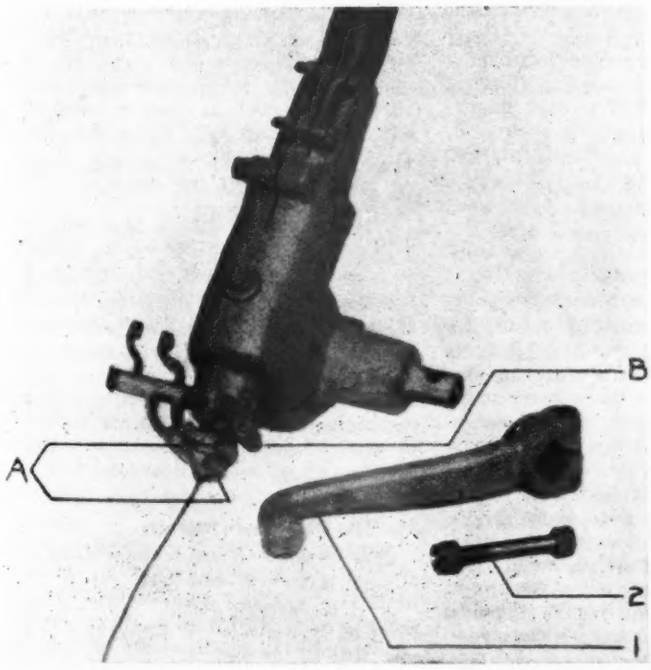
Adjustment Model K

The up and down play of the worm is adjusted by means of the adjusting nut "H."

Wear in the worm gear may be removed by removing the ball arm "J," turning the steering wheel until the worm wheel shaft has revolved through 90 degrees. Assemble ball arm to shaft in new position. The side play of the worm may be taken out by means of shims placed under the thrust washers "P." These shims are .0025 inch in thickness and can be obtained from the car manufacturer.

Lubrication

Same as model "M."



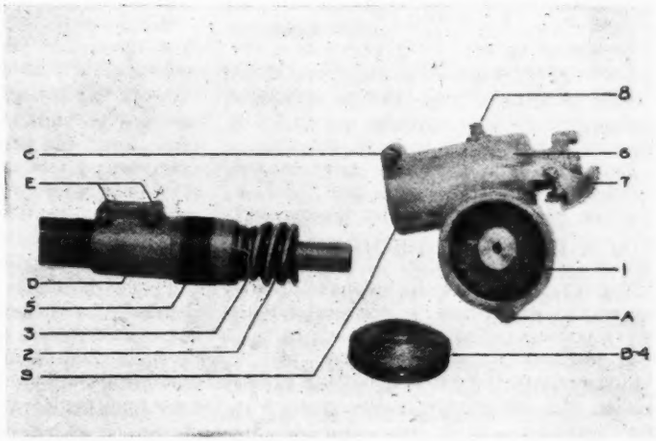


Fig. 7
Disassembled view of the C. A. S. gear

THE WARNER

The Warner is also a worm and wheel type and is furnished as equipment on the following cars: National, American, Durant 4, Davis and several models of cars which are now out of production.

Drawing in Fig. 6 shows three views of this gear.

Adjustments

In the course of a long period of service the gear may wear to such an extent that there is a slight up and down motion in the steering column. This may be removed by tightening the large adjusting nut shown in the drawings, at the top of thrust bearing directly over the worm. Nut should be tightened just enough to remove the up and down motion, as further tightening will pinch the bearings.

Adjusting for Side Play

Side play in the worm gear is indicated by lateral or crosswise motion in the cross member attached to the crank. It is removed by taking up on the screw cover, screwing directly into the side of the steering gear case as shown at Fig. 6 "B." A clamp bolt which secures this adjustment must be removed when adjusting and replaced to lock the screw plate after adjustment.

Adjustment for Worn Gear Teeth

Lost motion fore and after at the steering ball arm or crank denotes that the worm wheel teeth are worn. New teeth are brought into mesh by removing the ball arm of the gear shaft, turning the gear through 90 degrees, and replacing the arm in the new position.

Eccentric Bushing Adjustment

The above enumerated adjustments should ordinarily be sufficient to remove all lost motion in the gear, but in extreme cases it may be necessary to get a closer mesh of the worm wheel to worm teeth, which is accomplished by loosening the set screw as shown in "B" and turning the eccentric bushing in the case. A slight movement of the eccentric bushing will move the worm deeper into engagement with the worm wheel. Milled notches in the end of the bushing permit it to be rotated in the case.

Lubrication

Grease cup on hub case, graphite grease, weekly.

Pipe plug on case barrel, graphite grease thinned with cylinder oil, or 600W oil alone, every 4,000 to 5,000 miles.

Several oil holes in the hubs of the spark and throttle levels and hub of steering wheel, light cylinder oil, monthly.

C. A. S. WORM AND WHEEL TYPE

The C. A. S., which belongs to the worm and wheel type, is conventional in every respect. The gear is made in several different model numbers, all of which contain the same actuating mechanism, the differences being mainly in the arrangement of the controls for spark and gas and the method for locking the adjusting nut. A view of one model of this gear is shown at Fig. 7, and b. The gear is factory equipment on the following vehicles:

Lexington	Chandler
Monroe	Cleveland
Pan American	Climber
Saxon	Driggs
Stephens	Earl
Templar	Elgin
Tulsa	Falcon

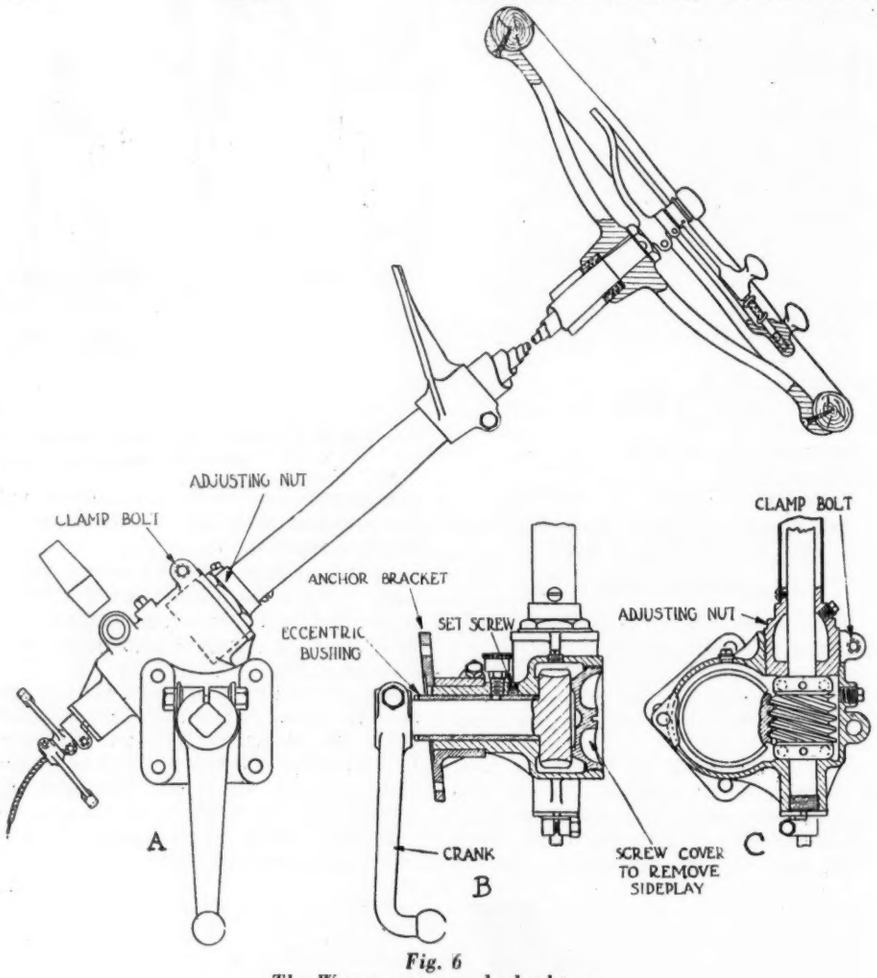


Fig. 6
The Warner worm and wheel type

TRUCKS

Atlas, M, D.
International, S.
Norwalk, 25E, 35E.
Patriot, Revere Model.

Adjustment

Two adjustments are provided, one to remove the up and down play in the steering column shaft and the other to remove the end play in the wheel or pitman shaft. To remove the up and down play, proceed as follows: At the top of the steering gear housing, Fig. 7 "A," will be found a collar that has notches cut in it. Loosen the bolt holding the collar and turn the collar in a clockwise direction to tighten (some models of the gear having a different method of locking the thrust adjusting nut). Be careful not to draw it up too tightly. Try the adjustment in several positions of the steering wheel. When correct adjustment has been made, lock bolt.

Loosen locking device at side of gear housing (locking device on most models are clamp bolts) by loosening the clamp bolt, then turn large nut No. B4, Fig. 7, in clockwise direction to tighten. The large nut is equipped with a countersunk head and the thread is a right handed one. Some models do not have the threaded large nut to take up the worm wheel shaft end play, in which case the adjustment is made by the removal of one or more of the spacing washers which are exposed when the housing plate is removed.

Further adjustment to take up wear between worm and wheel is made as on the other types of worm and wheel gears by removing the ball arm and rotating the wheel through 90 degrees. A new slot will have to be filed in the pitman or wheel shaft to allow for locking the steering ball arm in the new position. Turning the shaft through 90 degrees brings new teeth on the worm wheel into mesh with the worm.

Lubrication

Gear housing should be kept filled with a good grade of non-fluid oil or very light cup grease. Every three months the pipe plug should be removed and one gun full of heavy gear oil be injected into the housing to thin the grease.

To be continued in an early issue.

Consider Paint As An Aid in Selling Used Cars

Also a Good Paint Shop Will Keep Many of Your Customers' Cars on the Road Instead of in Your Used Car Yard

By G. KING FRANKLIN

THE used car problem is, today, the universal subject of conversation among automotive dealers. Various panaceas have been suggested, but so far none of them is operating automatically to relieve the situation. The subject of reconditioning the used car for a new lease on life has been much discussed and often tried. Some of these efforts have been costly failures and some have in a measure succeeded. Perhaps most of the success have been in the larger cities.

One cause of failure of these plans looking to the reconditioning of the car has been the neglect of the body. The sales availability of a car, whether new or old, depends very much upon the appearance. A very large percentage of the used car buyers still have the social side of the use of the vehicle in view.

Merely because a man is buying a used car does not indicate that he has no pride in the appearance of the car. In fact, it would seem that to overcome his suspicion as to the qualities of the chassis, it might be necessary to make the body even more to his liking that was the original. This should not be very hard to do, considering the number of cars that are turned out in the mournful black.

This leads to the real objective of this article—the extension of the paint shop activities. Many a good car has gone to the junk heap of delivery wagon because the body was a fright. Many a dealer has been stuck for a heavy loss on a car that had the making of a good vehicle because he put his work on the chassis and then did not doll up the body.

Paint will not be a panacea for the used car problem, but it should be considered on part with the chassis work.

The country is quite well organized to give service on mechanical, battery or tire troubles, but sadly under-organized to give adequate service on refinishing (painting, trimming and enamelling), and in order to determine just why such a condition exists a questionnaire was directed to various representative garages and service stations, asking if they had a painting department and if not, why?—Six typical answers are as follows:

1. A—operates a paint shop in connection with his other service work as he finds the time—doing the work himself. He turns out a cheap type of quick work by using materials that do the work in one or two coats.
2. B—Operate a paint shop in connection with his other service work but does so by employing transient painters, or those obtained by advertising in city newspapers. Some of these are satisfactory, but as a whole, he states that they are unreliable.
3. C—operates a paint shop in connection with his other service work and does so by employing a responsible foreman-finisher and holding him accountable for the results obtained from the department. He states that he is making money.
4. D—states that he believes a good demand for painting exists but that he knows nothing about the work and is unable to get good painters.
5. E—states that there is nothing but Fords in his locality and does not think a paint department would pay.
6. F—states that his entire floor space is devoted to storage and repairs and lacks the room for a paint shop.

One of the six is operating a paint shop on a satisfactory basis. Two are doing so in a hit-or-miss way, and the other three are operating no paint shops at all. A is no doubt turning out the best sort of work that he is capable of, but cannot be catering to the best trade. He is using the so-called motor car enamels which do not produce the best grades of work. B's extremity is some competent painter's opportunity—he has the paint department but is not making proper use of it. The results obtained from any business, or department of a business, are largely dependent upon the human factors incorporated therein. C recognizes this and has placed his paint department in the hands of a competent forman-finisher who supervises everything and does the finishing himself. He alone is responsible to C for results. This is in contrast with B who probably knows little about the trade and yet hires and supervises his own painters. He might well devote his time to getting business and hire a competent foreman to turn it out.

This matter of hiring competent men is not always easily done—just as B states. The good ones drift towards high wages and this is not always to the small towns that need them badly. There may be an abundance of individuals who style themselves experts but comparatively few measure up to the standard. Many are specialists who have worked at some one or two operations and consider themselves competent to handle all because they have watched them done.

But automobile painting is not a trade that can be acquired solely by observation, and a first class varnish rubber, or other specialist, might perform his particular work in a large shop or factory for years without ever learning all the facts connected with custom-shop automobile painting. While most of the operations are fundamentally the same, there is still a wide difference between factory and custom-shop work.

The factory paint shop works almost entirely on new surfaces, which may be wood or metal, but the custom shop refinishes over old coats that call for various treatments, removes old coats and applies new, rectifies omissions that occurred at the factory, and does it all at a price that will meet competition. It is a task that requires knowledge and skill and cannot be successfully performed by the average paint shop hand.

The finisher, or one who applies the finishing varnish, is generally the ranking individual and in small shops he often performs the double duty of finishing and supervising,—being known as a foreman-finisher. A competent tradesman, capable of handling such work must be obtained and graded in the same way as other executives. It is not that the work is difficult or hard to acquire for one interested in learning it, but rather that it is positively necessary that it be so acquired before any venture is undertaken, or else someone selected for the responsibility who is properly qualified. Such a one might well be a foreman-finisher.

We know that there are many owners of the C class scattered over the country. Gratifying reports are to be had regarding them and we regret that space does not permit our printing the detailed stories of some of them. The evidence shows conclusively that where competent men are in charge, paint departments are making money.

And now to get on with the discussion let us see what is happening to D. This man says that there is plenty of work at hand but he lacks a knowledge of painting and is unable to get anyone who has it. This is a condition that prevails in more than one small town, and yet it can be overcome by either D's acquiring the necessary skill and knowledge himself, or else by deputizing some employe. One way of learning the work is to hire out as a floor hand in a custom shop; but care must be taken in selecting the shop because all of them are not operated the same, and it might be D's bad luck to get into one where he would learn the work incorrectly.

Paint shops cannot be gaged solely by the sign that hangs before their door.

Another practical and rapid method of acquiring a knowledge of the trade is by taking a course of instruction in some school, where theory is taught along with the practical work—such as the Chicago College of Auto Painting. It is not a trade that can be acquired by simply reading some instructions, but one that requires study, practice and diligent attention to details—but for those who have the will there lies the way.

D might also try advertising for a competent painter in some of the city newspapers. To weed out a competent man from the replies is not easy, but is the only available solution where there is a lack of local talent or anyone with the desire to learn the trade.

E has a mistaken idea that all automobile painting is the same and that there is only one grade of work. Fords need painting the same as other cars and cheap work can be done as well as expensive. In the best grades of painting as many as a dozen coats of material may be applied from the metal up to the finishing coat of varnish. The work starts with a priming coat which acts as an elastic anchorage for the coats applied over it—then on the body panels comes three or four coats of a surfacing material which is rubbed or sanded down after being applied so that it is perfectly level and free of defects. This work is called surfacing and is done to build up a good surface that can be decorated with the color and varnish coats that follow.

This decorating is accomplished by means of one or more coats of flat color that establishes the proper groundwork of color, one to three coats of color rubbing varnish, each of which is rubbed to a smooth surface when dry, then striping, monogramming and finally the finishing coat of varnish which protects all of the coats applied before.

In repainting, where the work is done over old coats of paint, the use of surfacing materials is not usually required, and the number of coats of color or color rubbing varnish applied depends upon the type of the job. Thus, one might apply one coat of color rubbing varnish and one coat of finishing varnish in a moderate priced type of work, while for more expensive work the job might consist of one of two color coats, two or three color rubbing varnish coats and the finishing coat.

And by the use of the so-called motor car enamels the work can be further simplified and cheapened; for these enamels are combinations of color and finishing varnish and applying one coat answers the double purpose of applying a color coat and then finishing varnish. Of course, where so applied in one coat, the covering power of the color must be strong enough to do the work satisfactorily. Thus, one coat of black or dark enamel would cover well over black or dark blue old coats, but one coat of yellow would not. Such enamel jobs possess fresh color and luster but lack the durability of the two coat jobs.

All of this is explained in order to show how a variety of operations can be employed to obtain different priced grades of work. Thus, in the case of E, if as he states there are none but Ford owners in his locality, it is obvious that some type of job can always be devised to meet the conditions. The grade of work which employs the enamels can be done reasonably and a profitable source of revenue developed therefrom. Service on paint is of vital importance to all car owners who take an interest in the upkeep of their cars. It is not unusual for some to ship their cars a thousand miles or more in order to have them painted in a large city shop; and drives of a hundred miles or so to a paint shop are quite common.

F states that he lacks space. This matter of space is one that deceives many who would like to make paint shop installations. They have the idea that painting can be done only in secret rooms, while as a matter of fact, any of the coats can be applied right on the service floor. Light cloth screens can be arranged around the car in order to keep out the dust when applying the finishing coats, and floor lamps can be used to overcome the terrors of dark corners. Painting can be done under artificial light as well as in daylight. Heat must be provided during the winter months and this can be done by partitioning off a section with wall-board and installing a radiator or stove.

There is still another item of interest that F's situation suggests, and that is that there are quite a number like him and D scattered over the country and grouped in cities. Where grouped their difficulties, so far as supplying the demand for refinishing is concerned, have a common solution. The opportunity is offered them of starting a community shop devoted to automobile refinishing that will serve as a paint department for all of them. Painting, trimming and enamelling can be done and modern equipment installed for doing it.

Right now is the time to get the paint department started. The time approaches when many cars will be laid up for the winter's overhauling; and why should not a paint job be sold as well? Every car owner is at times a prospect that can be approached on either or both. Prospects for overhauling are more or less problematical—that is the necessity for the work is not always so apparent that its need can be readily sold—but lifeless or diseased paint coats advertise themselves.

Cars on the street that need repainting can be picked out at a glance, their ownership determined and the owners approached either in person or by letter with a genuine sales talk that tells exactly what is needed and what it will cost.

Such prospects are ready-made—they cannot deny the necessity for the work so it is simply a matter of selling price or quality. The business can be had everywhere and, like the untapped oil field, awaits only the drill of the man who knows that its riches are there.

A car that receives the average amount of service should be refinished, repainted, or otherwise looked after at least once a year; and with a total registration of over ten million cars, paint departments need not worry about their supply of business. When times are good there is brisk trade everywhere, and when they are bad old cars are repainted and made to last another year. The vast majority of cars taken in trade by dealers are refinished before being offered for sale.

Practically everyone connected with the industry is convinced that there is plenty of refinishing work to be had and the service man sees no end to it. For the service station to get its share is simply a matter of organizing for the work. Whether the predominating cars in a locality are Fords or Packards, the need for refinishing exists and preparations can be made accordingly. If the garage owner or employee is interested in learning the work, all well and good, it can be done. If not, local or outside talent must be obtained.

Whatever steps are taken to get a paint department under way the one who takes them may rest assured that he is working into a profitable branch of the service field where the returns are certain, with good business methods employed.

Motorboat Nomenclature Studied

AT a meeting of the S. A. E. Motorboat Division on Sept. 28, in New York City, the importance of establishing a definite motorboat nomenclature was discussed and a subcommittee appointed to study the situation and advise as to how the work should be carried out. The subcommittee appointed consists of Irwin Chase of the Elco Company; W. J. Deed, a naval architect of New York, and Leonard Ochtman, Jr., of Joseph Van-Blerck, Inc. The committee will obtain information as to the current nomenclature used by the engine and boat builders as a basis for determining the scope of the committee's work.

Other subjects which the division is working on are motorboat couplings, exhaust manifold connections, tachometer drives, stuffing-boxes and propeller shafting. The work in connection with stuffing-boxes covers only those dimensions which affect interchangeability.

The division also plans to take up the consideration of interchangeability for marine hardware and other boat parts. There is a real demand for such standardization, as it is appreciated that it will decrease production costs, making it possible for boat builders and users to obtain body hardware at less cost.

Six Fundamentals of Tractor Selling

Iowa Dealer Who Has Made Money on Farm Motive Power Tells How He Did It. Service Easier Than on Road Vehicles

By FRED M. LOOMIS

"TELLING the truth about the machine, and recommending only the size of tractor which is adapted to the conditions it must meet," are the two cardinal factors which make for success in the tractor business, according to "Jack" Miley, of Miley Bros. & Co., Chariton, Ia.

"Jack" has the reputation in this community of being able to sell a tractor to a farmer whether the latter wants one or not. Once let "Jack" make up his mind that a certain farmer needs a tractor, it's all over but the shouting. That farmer might just as well put his name on the dotted line one time as another because he buys, once "Jack" gets after him—that's all there is to it.

"But there are farmers and farmers," says "Jack." "Some farmers you can't trust with a bicycle, let alone a tractor, regardless of their apparent need for one. They'd gum up the works if they tried to run a wheelbarrow, so lay off those birds; selling one of them a tractor is just going out and picking up trouble.

Pick your farmers, investigate their needs on the basis of the acreage they work and the character of the crops they grow, then show them that under any and all circumstances a tractor is more useful and more economical than horses.

"Can I do this? Sure, I can. All I've got to do is to tell them about my own experience. I work a half section farm, all in one piece, and I've had a tractor for four years. I keep an accurate account of my costs and on my books I have perhaps a dozen different departments to which I charge them.

"At the end of a year I can tell to a cent just what every operation on my farm has cost me. It's a long story to tell how I proved it, but the conclusion is that my tractor actually paid for itself its first year, by getting my crops in on time when it would have been impossible for me to have done so with horses. Its maintenance cost during all that time has been less than the cost of repairing the harness I still own, the tractor grinds feed for my stock; it does all my threshing; it saws my wood; it works my roads, and in every operation it is more rapid, more efficient and more economical than horses, for the same work.

"But to make that record I had to have a tractor adapted to my needs. This means a 3-bottom tractor in my case, and it will mean a 3-bottom tractor for any other farmer who works from 200 to 320 acres. Should the farmer work only 160 acres, a 2-bottom tractor is all he should have and, should his farm be as small as 80 acres, he should have no tractor at all.

"The relations between size of farm and size of tractor are fundamental and important and should be indelibly impressed upon the mind of every man who undertakes to sell tractors in an agricultural community such as this.

"So that's the foundation, actual experience on my own farm, upon which I base my solicitation for tractor sales, that and my knowledge of the mental and mechanical characteristics of the men whom I solicit.

"Now I've sold some 40 tractors since I went into the business; 27 of them the first year, but not so many during the last two years, because of business conditions. During that time I have learned a few things. Some of these are:

"First: Any machine which is mechanically efficient for the work for which it is adapted is here to stay. The tractor is such a machine. Hence the tractor business is coming back and I'll say I'm here to take advantage of that fact when it happens.

"Second: Any farmer who starts farming with enough money to buy a motor car, or a motor truck or a tractor, would better buy the tractor, for the reason that it carries more possibilities of economy of operation in handling farm tasks and is a greater potential money maker, than are any of the others.

"Third: The farmer who buys any tractor for farm work, such as is common in this locality, is foolish if he buys a machine which weighs more than 3,500 lbs. The reason is that the heavier machine will cost more pulling its own weight over plowed ground, than the lighter machine will cost with a disk harrow behind it.

"Fourth: Any man who undertakes to sell tractors, be he automobile dealer or otherwise, must start with a knowledge of both the possibilities and the limitations of the machine he sells. It will be better for him, of course, if he has gained this knowledge through practical and personal experience, as I did, but this is by no means necessary.

"Failing the personal experience, it should be easy for any man who is a real salesman to apply the knowledge and experience which has been gained by other men and which is available for his use. There is no mystery nor difficulty about selling tractors if only intelligent use is made of available knowledge and this any dealer can do, whether he comes from the automobile field or from any other field.

"Fifth: He should never sanction the purpose of any size tractor other than that which he knows is fitted to the needs of the purchaser.

"Sixth: He should present his tractor just as it is—in other words, tell the exact truth about it.

"So then I got out to sell. How do I do it? Well, I place all these facts in black and white right under the eyes of my prospect. The average farmer does not figure, or rather, he does not figure as he ought to. For instance, he draws a check, let us say, for $20 worth of gasoline. When that check comes back from the bank it looms large in his eyes as an item of expense and is charged up against his tractor.

"So, also, what he pays for repair parts, overhauling or service. All of these things count as tractor expense in his eyes because they are tangible outlays. But does he know what it costs him to plant, to cultivate, to raise, to harvest, to crib his crop? He does not.

"All he knows is that he takes a basket, goes to the crib and carries a bushel of corn to his horses. He has no more idea than a rabbit of all the overhead that has gone into the production of that bushel of corn.

"So I sit down with him and figure it out. I show him the actual cost of the ground feed his horses consume—normally, the produce of about five acres per horse, regardless of what the market value of that produce may be at the time. I figure the cost of the hours, he, or his help, spend in caring for the horses and so forth.

"Then, by way of contrast, I show him my own figures of what it has cost me to do the same work with my tractor, which invariably is less than his horses have cost him.

"This record is an eye opener to him and the result is that he does just as I did, buys a tractor and sells part of his horses, although I went at it the other way around and sold my horses first.

"When I sell a tractor, I tell my customer that I will deliver it, start it, stay with him long enough to be sure that he understands it and knows how to run it and that then I am through. Any at-

tention he demands after that he is expected to pay for.

"I find that the service men in our shop are fully competent to take care of tractor service. As a matter of fact, the service on tractors is far more simple than is service on motor cars. The common tractor magneto is the simplest of all ignition devices and a magneto and a few short wires to the spark plugs are all there is to tractor ignition. Aside from that, there is nothing but the simplest type of 4-cylinder gas engine to service, and any ordinary mechanic can take care of that.

"There is no fundamental difference between the servicing of tractors and the servicing of motor cars, except that the former is easier and simpler.

"During our first year, when we sold the largest number of tractors, many of our customers brought their machines to our shop where we overhauled them from stem to gudgeon. The next year most of our service was in the field. This year fewer tractors have been at work.

"When we were busy, we kept a special tractor service man and a service truck, the latter equipped only with small tools and a few of the smaller replacement parts. This we have discontinued this year, but we will begin it again when the tractor business comes back.

"Yes, sir, there's good money in the tractor business. We made money when trade was good and we'll make money again when trade comes back, as it surely will."

Miley Bros. & Co. are automobile dealers, selling Dodge Bros. cars, Reo cars and Speed Wagon, and Hupmobiles. The company carries a stock of tires and automobile accessories as well. Wallis and Samson tractors have comprised the farm equipment line. The company has a commodious and well equipped repair shop and does a prosperous and growing business. Of the automobile companies in Chariton, it has been longest in business.

Touring Car Versus Phaeton

By GEORGE J. MERCER

THE writer, as a member of the S. A. E. Standards Committee that was responsible for the nomenclature of automobile bodies adopted by the Society of Automotive Engineers, desires to answer criticism of the change from "Touring Car" to "Phaeton," which was approved by this committee.

Due consideration was given to established practice and to the fact that the committee was setting a standard for the future as well as for the present. Consideration was given also to the origin or derivation of the names.

One or Two Broughams Shown

As proof that the committee bore the above considerations in mind, take two of the names selected, "brougham" and "cabriolet." Neither one has a derivative sense as used. There are several distinct outstanding features that are characteristic of the type of body known as the brougham in the carriage days and in the early days of the automobile, that are lacking in the automobile body the committee has selected to bear this name. At the Salon one or two genuine broughams are invariably exhibited. Yet the committee has given this name to the type shown on page K23 of the S. A. E. Handbook (copies of data sheets enclosed) because the general public had seen fit to use the name selected.

"Touring" Applies to All Types

In addition, it was felt that the older or original type was not suitable in general for use as an automobile body type. We agreed, therefore, to pass nomenclature on to successors and in naming both the brougham and the cabriolet, we were actuated solely by the fact that the public commonly recognized these bodies by the terms mentioned.

One reason the committee chose the name "phaeton" was that the term "touring" applies to any particular type of body because all types are used for touring, but that was not the only reason. This type of body is the logical successor of the family horse-drawn open carriage known as the phaeton. It was so called in the earliest handbooks issued by the Association of Licensed Automobile Manufacturers. In the 1906 Handbook, Packard, Walters and Stevens-Duryea used the name "phaeton," Pierce-Arrow designated the vehicle in question as a "tonneau" and others used simply the series letters or numbers of the respective models without names. Later, as the design was changed and became a flush-side body such as we know today, "torpedo" was the common name in Great Britain, and was used to some extent in this country; while in France the use of the name "phaeton" was general. Packard, Franklin, Cadillac, Stevens-Duryea, Cunningham, Pope-Hartford and Thomas used the name "phaeton" in the 1913 A. L. A. M. Handbook. Hudson has been a consistent user of this term.

Has History Background

This certainly warranted the committee in concluding that the name "phaeton" had a logical right from a priority point of view, based solely on automobile custom, to contend with the name "touring car." Furthermore, as a name it has a wonderful background of history. It is associated with the type of carriage that people have owned and used beyond our memory. It is also applicable to the more expensive carriages that were exhibited at the horse shows.

Referring to the term "roadster" being retained, since all types of car are used on roads, we must again refer to the rules and conditions that governed our work. We gave first consideration to established procedure, and chose between the merits of the existing and, to our viewpoint, contending names. "Roadster" and "runabout" have been from the beginning the two most popular names for this type of body. The committee chose the first. The matter is simply one of opinion. The term "roadster" has slightly the lead in popularity in advertising and catalogs issued by passenger-car manufacturers.

As it was the task of the committee to select one name from the several in use for each of the various types of body, due consideration was given to the claims of all and the decisions were based on the basis outlined herein. We feel that our work has met with general approval.

Salesman Sees Profit and Health in Car

Better business and healthful recreation are the chief assets of a motor car, in the opinion of Felix Block, 137 East Broadway, New York, who reecntly won an automobile in a *N. Y. Evening World* contest. Says Block: "I suppose every one wants a car. I know I do. It comes in handy. You see, I'm a salesman of knit goods, and I can use it in my work. But even more than that, I've been wanting one to take my mother out in. She isn't very strong, and—you should have seen how delighted she was when she heard I'd won it!"

Motor Truck Output 27 Per Cent Above Last Year

Reports of the U. S. Department of Commerce record that motor truck production in September, 1922, was 27 per cent above September, 1921, though showing an expected decline from Summer business. The output for September this year was 18,843, for August this year 24,200 and for September, 1921, 13,648.

Moving Jennings, Michigan, by Truck

The town of Jennings, founded about twenty-five years ago, is being moved today by motor truck to Cadillac, Mich., a distance of 11 miles. The houses to be moved vary in size from 24 by 30 ft. to 24 by 40 ft. The 11-mile trip is made in about four hours.

Business Cars Tax Free in Danzig

Motor cars used by doctors and other professional or business men for transportation in their daily work are exempt from taxation in Danzig.

Winter's Effect on Electrical Equipment and Accessory Sales

By A. H. PACKER

How Storms Affect Electrical Systems

WHEN a car gets stuck due to a storm, a possible cause of the trouble is in water getting on some part of the ignition system, where it can cause a leakage of high tension current.

In Fig. 1 is shown a spark plug in which the various possible paths for the current are indicated. The normal one, of course, is down through the center and across the regular gap in the form of a spark. With water on the outer part of the insulator, however, the current from the coil may leak to the engine to such an extent that no spark jumps at the regular gap.

This condition is sometimes encountered on foggy or damp mornings, when enough water collects on the surface of the spark plug insulators to prevent starting the engine unless the plugs are first wiped dry. While having no particular bearing on the condition of the weather, two other possible causes of plug trouble are also shown in this sketch, these being leakage due to a crack or due to carbon deposits on the portion of the insulator that extends down into the cylinder.

In Fig. 2 a condition on Ford cars is shown which sometimes gives trouble in wet weather and accounts for the rubber blanket or poncho sometimes seen closing up the opening between the hood and the body. The terminals that may cause trouble are the four lower or high tension ones. Although these are protected with porcelain sleeve type insulators, the protection is not perfect. Water running down the front or engine side of the dash will find its way through the clearance holes through which the terminals project, giving wet surfaces as indicated.

In Fig. 2, as soon as the water works through the clearance hole in the dash and gets the coil box wet, there will be a leakage as shown by the short arrow, and the high tension current will flow through the wet dash to ground instead of jumping the plug gap. While the writer does not know of its being tried, it would seem as if sealing the clearance holes in the dash with wax of some sort after the coil box had been installed would overcome this condition, as the porcelain is O. K. for insulation as far as it goes. The common method of correction is a sort of eve trough made to collect the water that works under the hood and carry it to one side where it can do no harm. If the wood of the coil units themselves should get wet this would make conditions even worse, and require new coils or a thorough drying of the old ones before successful operation could be obtained.

The ignition system shown in Fig. 3, which is a type that is used on many cars, is only slightly subject to moisture and

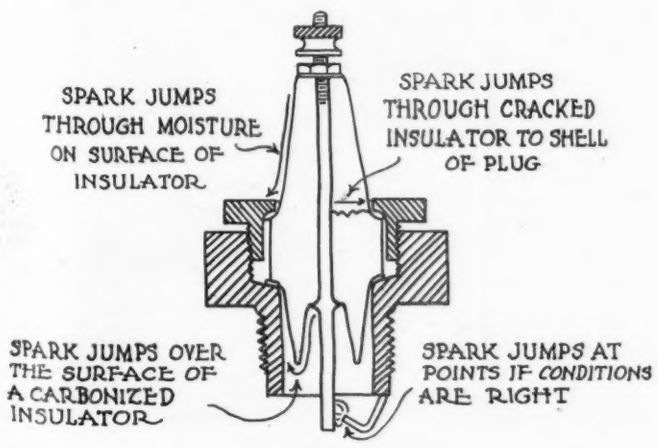

SPARK JUMPS THROUGH MOISTURE ON SURFACE OF INSULATOR
SPARK JUMPS THROUGH CRACKED INSULATOR TO SHELL OF PLUG
SPARK JUMPS OVER THE SURFACE OF A CARBONIZED INSULATOR
SPARK JUMPS AT POINTS IF CONDITIONS ARE RIGHT

Fig. 1

Various Paths that Spark May Take at Spark Plug

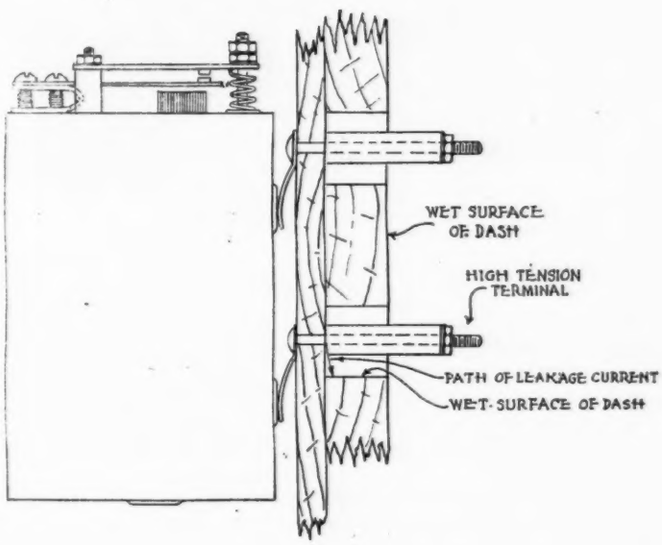


Fig. 2

Path of Spark on Ford Car With Wet Dash and Coils

practically immune if kept clean.

One theoretical path for leakage current is from the high tension terminal at the side of the coil to the grounded base. Practically, however, the coil is made of such a material that the water does not form in a film but rolls down in drops like water off a duck's back, so that there is not a continuous conducting film, and no harm results. Should the coil, however, be allowed to become covered with a layer of oil and dust, it will be found that the water will be held in this film and may cause enough leakage to give trouble in the ignition system.

In the same way on the distributer cap there is a possible leakage path from the high tension leads, for the different plugs, to the grounded snap clips that hold the cap on, but

Heating Accessories Produce Winter Sales

THE motor car is being recognized more and more as a necessity rather than as a luxury and, along with this change, its use in winter is being increased. From the standpoint of transportation, its need is even greater in winter than in sum-

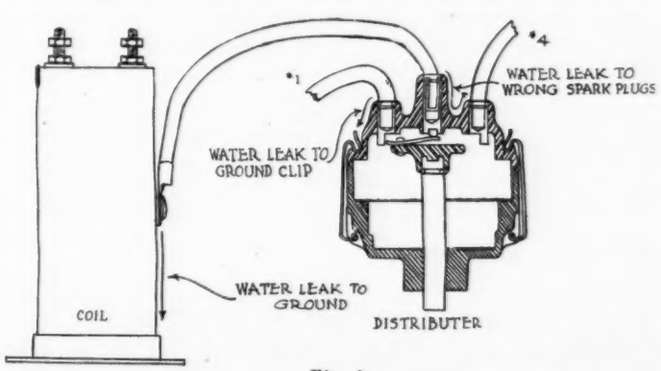
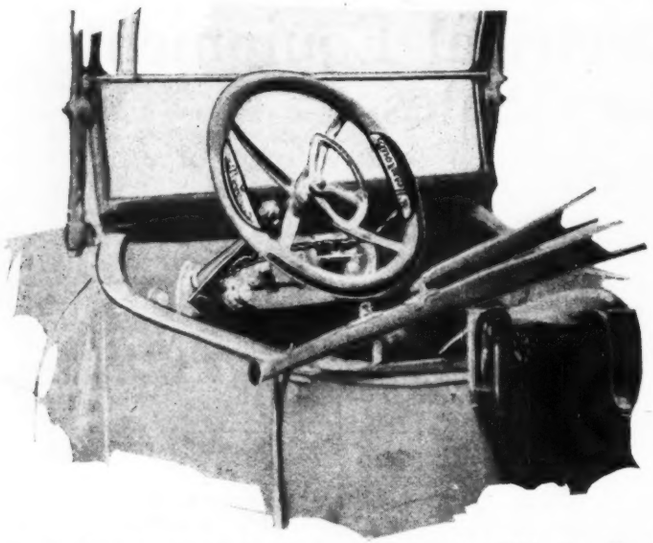


Fig. 3

Path of Spark on Typical Ignition System Due to Dirt and Water



Hand Warmers Avoid the Necessity of Driving With One Hand While Sitting on the Other

here also there is slight chance of trouble if the surface is wiped off occasionally. Due to the fact that the spark jumps easier when not under compression, there is also a chance for leakage to a plug in a cylinder that is not firing, as shown at tne wire marked No. 4.

This type of ignition is, however, nearly waterproof if kept clean.

mer, for in getting to business, to church or to the theatre, the difficulties due to rain or snow make it practically indispensable.

This tendency for the car to be used the year around is a vital one to the motor car dealer, for it means a reduction in the extent of the slump, which often comes to the industry with the approach of cold weather. The dealer, however, must be constantly awake to do his part in making it both easy and pleasant for the owner to operate during the colder seasons, and to the business man, in the habit of using a warm suburban train, the thought of driving the car does not always appeal.

Increased sales of inclosed cars have shown a movement in the direction of getting twelve months' use from the automobile, and the idea of winter driving comfort can further be spread as devices are developed, sold and used, which void the objections of the train loving commuter.

For the production of heat in quantities, the exhaust gas is utilized, but for other devices such as hand warmers, the storage battery is used, and its supply of electrical energy is converted into heat by allowing current to flow through suitable resistance coils.

The hand warmers illustrated use 3 amp. at 6 volts, which is about the current used by a 21 hp. head lamp bulb, the watts being figured by multiplying volts by amperes, which gives 18 watts as the heating power of such a device. When it is realized that an ordinary 60 watt lamp gets so hot that it burns the hand when an attempt is made to unscrew it from its socket, it can be seen that even one-third that amount of energy will produce considerable heat. Furthermore, comfort in handling the steering wheel does not require excessive heat, but merely that the chill be taken from the surface, so that the hands do not get stiff or numb from a long period of driving.

Devices of this kind, accordingly, have two functions. First they provide immediate opportunity for increased winter business, by the sale of the device in question and by its installation as well. The second effect is indirect but equally important, being to encourage the all-year use of the car, which necessarily results in increased business in the sales and maintenance departments.

Electrical Aid for Vaporization

AMONG the causes of reduced winter business, we find that trouble due to starting in very cold weather is as prominent as any. The timid car owner starting out for some place where his car must be left outside, will have the pleasure of the trip marred by the thought of a cold engine, weak battery, and starter unable to give the necessary cranking speed to the engine under such adverse circumstances.

With good vaporization of the fuel the slow cranking speed is no longer such an important consideration, and the answer to good vaporization is heat. After the engine has been run a few minutes, the hot spots and similar devices employing the exhaust gas take care of the situation very well, but at the time of starting this heat is not available. The only source of heat on the car is the battery, which can furnish current to be used in a heating coil of some kind.

Figures given on Master Primers which combine priming with electrical heating are as follows:

Starting Conditions, Primer Not Used

Starting current, 200 amp.

Time required to start, 20 secs.

Energy used up, 4000 amp. secs.

Starting Conditions with Primer

Starting current, 200 amp.; primer current, 24 amp.; total 224 amp.

Time of starting, 7 secs.

Energy used up, 1568 amp. secs.

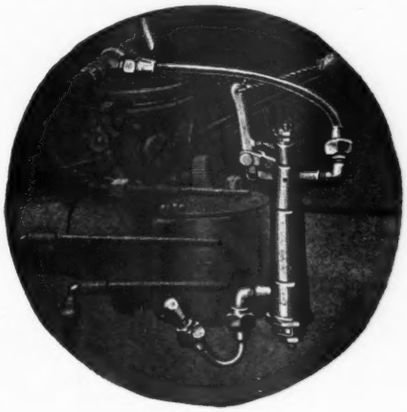
From the above table of values it can be seen that while the temporary current draw is increased, the reduction in time required to start will really reduce the amount of energy taken from the battery, so that there is much less chance of the battery requiring charging due to cold starting conditions.

Devices of this type fall in two general classes, one of which is usually employed between the carbureter and the manifold, and through which the incoming gas must pass. The other type combines priming functions with the heater, and forcibly injects heated gasoline vapor. There is not much question, however, but what either type would prove beneficial in facilitating starting.

This Attractive Enclosed Car Would Be Even More Inviting on a Cold Day if an Efficient Heater Were Installed

It is commonly recognized that water evaporates or vaporizes at lower temperatures than its boiling point, and further, that it will condense back into liquid form when cooled. A common illustration is the humidity of the air which blows across the lake, for it picks up a considerable quantity of moisture. Then let this same air blow against the outside of a pitcher of ice water, and the pitcher begins to sweat, that is, beads of water from the moist air form on the outside of the cold pitcher.

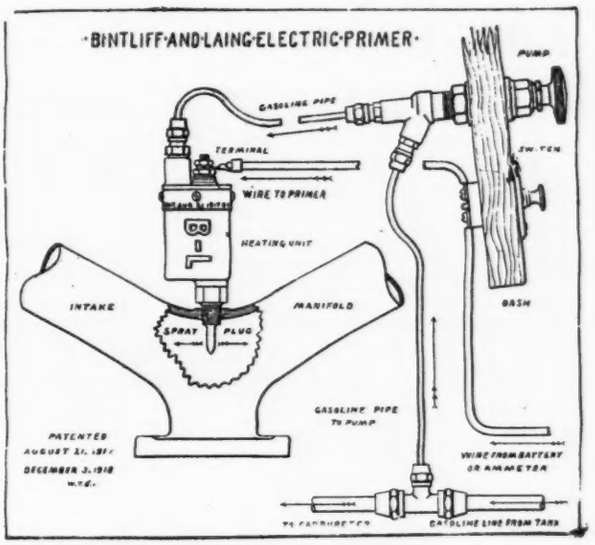
In the vaporizing of present day fuel, a similar condition is encountered, where the air rushing through the carbureter passages, vaporizes a portion of the gasoline. The carbureter and intake manifold being cold, however, there is a great tendency for the vapor to condense again, and drops of raw gasoline form on the inside of the manifold and are also drawn into the cylinders as raw gasoline instead of combustible vapor, which gives poor distribution, poor firing conditions



The Master Primer

and crank case dilution, due to the gasoline that runs down the cylinder walls.

This tendency to condense is greatly reduced, however, by having the vapor from the carbureter encounter some hot body such as an electrically heated coil. It is the ability of electrical primers to maintain the gas in a vaporized condition that makes them of value, not only from the owner's standpoint but from that of the dealer, who makes his customers regular users of motor cars in winter as well as in summer.



The B. & L. Primer

the expense of heating a garage is often out of proportion to the advantages obtained and to the investment represented by the car and building itself.

Trouble from cold storage of the car at night is due to many things which we might do well to consider. In the first place, there is danger of freezing the water in the cooling system, unless the percentage of alcohol is frequently checked with a hydrometer, and if freezing occurs, it not infrequently happens that the radiator is wrecked and the cylinder jackets cracked.

At low temperatures great difficulty is experienced in getting the gasoline to vaporize, and no matter how good the spark may be it is of no avail if there is no combustible mixture to be ignited. The battery is also very inefficient at low

Heater With Handle Easily Carried When Hot

temperatures, and combined with the stiffness of the oil when cold, produces a combination that results in cranking the engine very slowly, which not only puts a heavy drain on the battery, but due to the slow speed, gives poor suction in the intake manifold, which aggravates the vaporization problem.

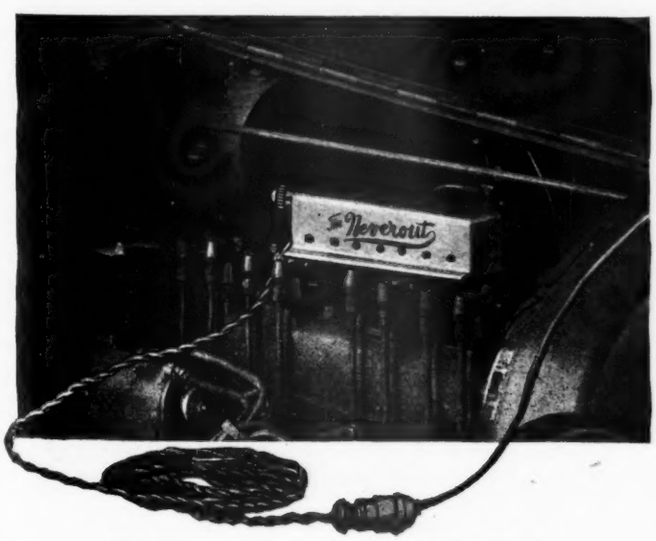
We will now consider what happens with a cold engine after it has started. The suction in the intake manifold now draws up both gasoline vapor and raw gasoline, the latter running down the cylinder walls, washing off the oil, and tending to cause scoring of the cylinders and pistons. The cylinder oil, moreover, flows with difficulty, so that the lubrication of the engine is very imperfect for some time. If under these circumstances the car is run rapidly, without first allowing the engine to warm up, there is great danger of damaging the bearings as well as the cylinder and pistons.

It is due to the difficulties above enumerated and to the expense of heating the whole garage, that electric heaters designed to go under the hood should find a ready sale, and the sale should include not only the heater itself but also a hood and radiator cover, if one is not already on the car.

Current used in these devices produces heat which is transmitted to either the cylinder block or to the radiator; in the latter case the water circulates and warms the cylinders as it flows through the water jackets. The heating efficiency, of course, depends on holding the heat in, where it belongs, so the effectiveness of these devices is greatly increased by the use of hood and radiator covers.

The Cold Garage and the Warm Engine

THE advantage of a warm garage can be easily appreciated by anyone who has tried to start a car after it has stood over night with the temperature down near the zero point, and yet

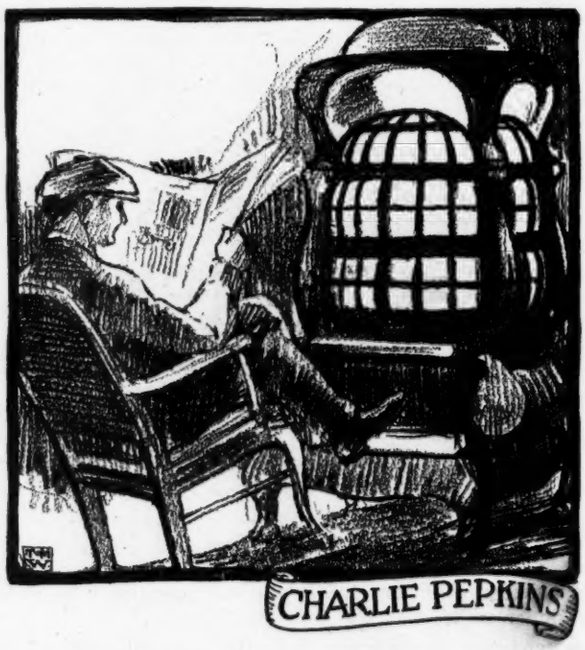


The Neverout Heater in Place Under Hood

The Fable *of the* Old Timer, *the* Expert *and the* Greenhorn Who Were Stuck *in the* Snow

By TOM WILDER

With Apologies to George Ade



OLD Joe Bush was a Pioneer Auto Fixer at Green Bend. His shops had been in operation for many years, almost as long as cars had been driven. Some thought that Joe Beat 'em To It and was waiting for them with ship shop all set up, but that doesn't matter, he made a good living, measured by Joe's standards, and that was all that was necessary—to Joe.

On the other side of town, and with about the same kind of a Layout, Charlie Pepkins Flashed a Busy trouble lamp during the driving season but during the long winter that flourished in Green Bend his principal occupation was Making Love to the Base Burner. With his feet upon the fender and his trusty Cuspidor Hard By he spent the months in friendly combat with the village loafers.

Joe was thrifty and always had a job to work on, even if it was no more than a piece of blacksmithing or machine work for the Knitting factory, but Charlie would not stoop to such jobs, being an Auto Expert, so when 90 per cent of the cars went on the shelf in the fall Charlie went with them and hybernated with the Grizzlers till Spring.

Both Charlie and Joe were good Mechanics, but of the One Man type; neither were able to direct a force of more than two others because they seemed unable to keep out of the grease themselves.

Jack Strong was of another Breed of Cats. He was not content to Let Come What May. He did considerable Hustling and some Cussing and when the deep snow came and Garagemen generally—Joe Bush and Charlie Pepkins in particular—crawled into their holes and pulled the holes in after them, he was, speaking mildly, surprised.

At first the experience was such a shock to him that he tried to Cash In and get into Another Line but there were no buyers for a business that was Dead and would Stay Dead for 5 months, so he had to Stick until it got good again and by that time there wasn't enough money in Green Bend to buy him out.

While he was sticking out the first winter Jack didn't Hold Down the stove and the Checker board like Charlie Pepkins nor did he make bread-and-butter money like Joe Bush by taking on irrelevant work. Jack's one Big Idea was to make his business a year around activity instead of the Feast and Famine proposition it was in most shops. All through the dreary winter his Think Tank was running at high pressure and before spring he was getting results that tipped him off that the next winter would be different.

His first Hunch was to sell his customers and the townspeople generally on winter driving, arguing to himself that if they were driving there would be service to be rendered and sales to be made. He watched the first heavy snows, and there were quite a few that year, and found that usually in a day or two the roads even in rural districts were broken so that cars could easily get through.

Armed with the knowledge that winter driving was possible, he got out a series of circular letters telling the facts and pointing out that the car if used was of greater service in winter than in summer; that it kept the feet warm and dry while making duty or pleasure calls around town or into the country; that the car contained its own heating plant if developed and connected up; that winter curtains, which he was prepared to install, converted an open car into a cosy and snug affair.

Many of his customers Fell for his Line and brought their busses around for Winter Prescriptions and equipment and started winter driving with much enthusiasm.

Finding success following his efforts he took on the agency for a winter top and started trying to sell it. But it was now getting so late in the season that there was little chance of making many sales involving so much money, so he Laid Off the Tops but stuck to the Curtains and got ready for the spring overhauling drive, which he launched and had going nicely by the end of February.

Jack found that the inhabitants of Green Bend and vicinity

were very susceptible to advertising. They had lots of time and Lapped up his letters and circulars without missing a word, as if they were personal letters from a close friend. In fact, they looked forward to getting them about every so often, just as they looked for the Green Bend Courier or Farm and Fireside. His talks were always in a friendly personal fashion, convincing but never dictatorial.

When he started his drive for early spring overhauling, for example, instead of throwing a lot of Bunk and vague exaggerations about doing the best work in the world, at the lowest price in the world, quicker than anyone else in the world could do it, he drove home a lot of truths. He told about the average rear wheel making 3,500,000 revolutions; the crankshaft 16,500,000 revolutions, and piston dragging along the cylinder walls 2600 miles or about half of the mileage of the car in the course of a year, how it is impossible to prevent some wear in moving parts, how improper adjustment and poor lubrication induce excessive wear, but how wear may be reduced to almost nothing by watching adjustments.

He wrote at length on the advantage of starting the season with clean bearings, tight and perfectly functioning valves and piston rings and showed that if the car were getting 18 instead of 12 miles per gallon the saving on gas alone for a 5000-mile season would pay for the service—the satisfaction of a perfect running car would come free and the saving on lubricating oil would be clear profit.

He pointed out examples of cars which had traveled 100 to 150 thousand miles when given attention, while others had Hit to the junk pile after a short career of 20 to 25 thousand. He got their confidence and after he had that Cinched, explained how much better it would be to start immediately and have the Old Bus rejuvenated. The job would then be ready a little ahead of the roads, thus getting the Drop on the procrastinators who would Blow In in swarms with the first suggestion of Spring Sunshine and Balmy Air and all want their work done Tomorrow.

The Gaff worked fine because it was All Wool and Fast Color. Jobs started coming in before the Drive was nearly finished so that while Joe Bush was holding his own with odd jobs for the knitting factory and Charlie Pepkins was toasting his shins by the Base Burner waiting for Zephyrus to dry up the mud and Breeze In some trade, Jack was Lining Up about half the Gasoline propelled population to take turns in his shop.

The comparative Greenhorn was Scooping the Old Timer and the Expert, because both were content to let their business run them, instead of Tapping their Think Tank for a method of Beating a Loosing Game. They were content to run along in the old established Rut instead of Putting on the Chains and climbing out to a better road.

Jack didn't spend all his time writing ads that winter, either. Whenever there was a heavy snow, which was one of Green Bend's Specialties, he would get out an old Track Layer which he had taken in Trade the fall before and Muss Up the drifts with a home-made plank plow till Green Bend's Boul. Mich. made the Home Stretch on a speedway look like a country road. And he never neglected to make all the cleared roads lead to his own door.

This little snow plowing act, while it did not pay him any Cash Money, made the car-driving inhabitants Sit Up and Take Notice and put them under a sort of moral obligation to him. Just as the car owner feels he should buy gas of the dealer who gives him Free air, so they felt indebted to Jack for opening the roads and quite naturally thought of him when there was anything needed in the accessory or service line.

The act also showed that he was public spirited and he immediately found himself slated on public welfare committees of all kinds and in touch with Influential People.

Altogether, through the injection of Pep, his winter had been transformed from one of hopeless prospects into one of interesting and profitable experience. He had jumped from the job of Scene Shifter to a Star Role with a place in the Spot Light solely through courage, effort and ingenuity.

He knew that on the foundation built this winter, future winter business would be Peaches and Cream. He also knew that someone would follow his tactics next season, but as Joe Bush was too old to Take On new Tricks and Charlie Pepkins didn't have the brains, all he had to watch were the new ones and they didn't Pound any Sand as yet.

As soon as Jack began to feel the effects of Winter Business his stock in himself began to rise and it was not long before he classed himself with Green Bend's leading Merchants and began to act accordingly. His building was one of the typical oil bespattered, grease soaked Dumps, that one always sees in a village like Green Bend, so when Jack found himself face to face with the Makings of prosperity, he began to consider what he could do to Look the Part.

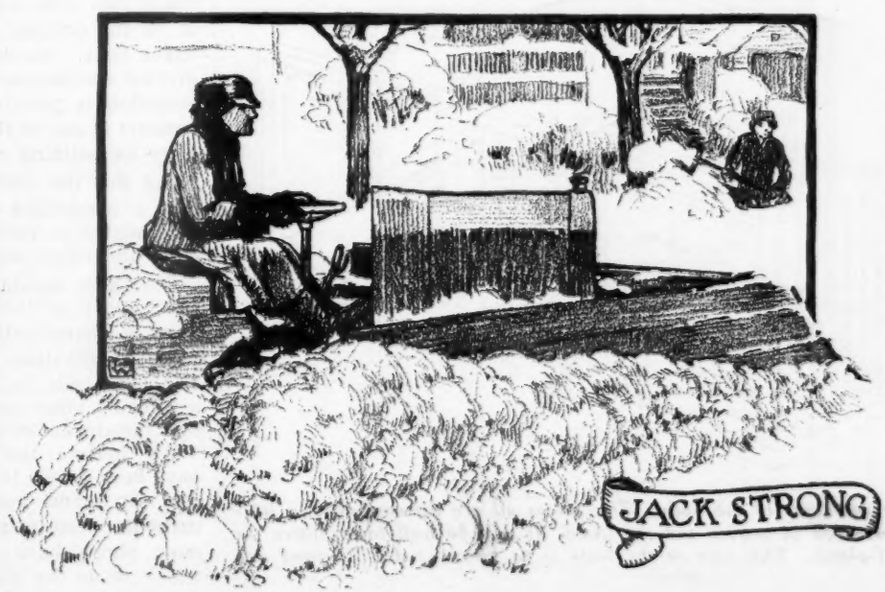
The first act was to rebuild the front of his establishment, removing the garage door and building a classy showroom and accessory store across the whole face throwing out the small high windows and replacing them with a low silled, broad expanse of plate glass that exposed the whole interior and allowed no chance for the Village Cutups to Get Fresh with his Cashier.

Above the Plate Glass was a decorative wall of tapestry brick and colored tile containing his name in large but well formed gold letters. Substantial brick piers at either side supported the wall and extended to the top terminating in Terra Cotta Caps.

It was not an expensive layout, aside from the glass, but it made everything else in town, including the Carnegie Library, look like 30 cents and when the illuminating sign—some 25 ft. above the top of the building—blazed out the fiery word GARAGE at night, no other place had a Look In on transient business.

The dark days of fall and early winter had shown Jack that light is an important feature so the wiring was overhauled and put in conduits with outlets in abundance so that there would never be a shortage of light or power at night or during the dark days.

New time Saving equipment was installed wherever the need seemed to justify the expense and the stockroom overhauled and put in charge of a likely chap whose business it was to keep it Ship-Shape.



Altogether the winter that had threatened to be a Waterloo was proving a Touchstone. While he was not making enough to pay for all the alterations and improvement, he was increasing his capital stock, his resources and his customers' good will, which, after all, meant more in the end than present profit.

MORAL—If there isn't a Bird in the Hand it pays to look for one in the Bush.

The Tow Car As a Business Getter

Plans and Specifications for Building a Car to Meet Needs of Average Small Town Dealer's Maintenance Shop

By B. M. IKERT

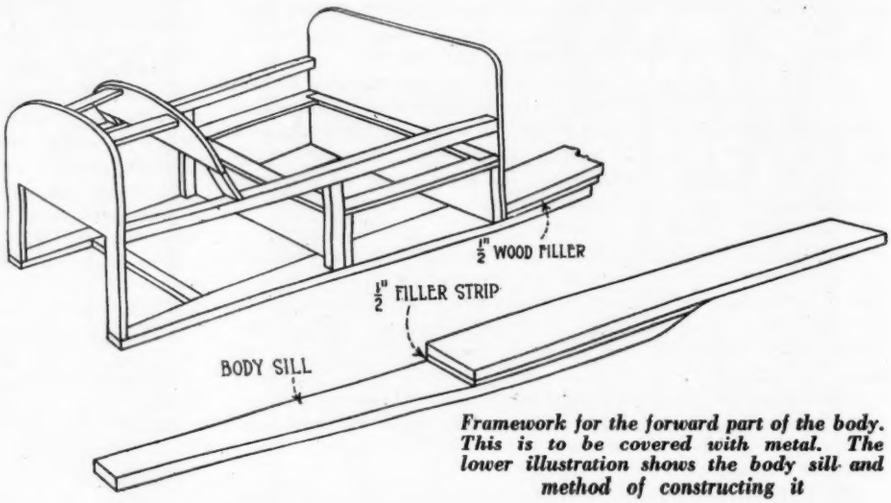
ONE of the profitable things the dealer shop, or the exclusive maintenance shop, can do during the winter season is to build and equip a tow car, "service truck," wrecking car or whatever we choose to call such a vehicle.

It is possible, of course, to buy a new truck chassis and have a special body made to fit it, but the majority of dealers and maintenance men will prefer to take an old model passenger car and rebuild it into a tow car. There are many old models still in good condition, but the bodies of which are quite out of date, that make excellent tow cars. The essential units should be in good condition because, surely, one wants a tow car to be reliable, especially when it becomes necessary to bring in a disabled car.

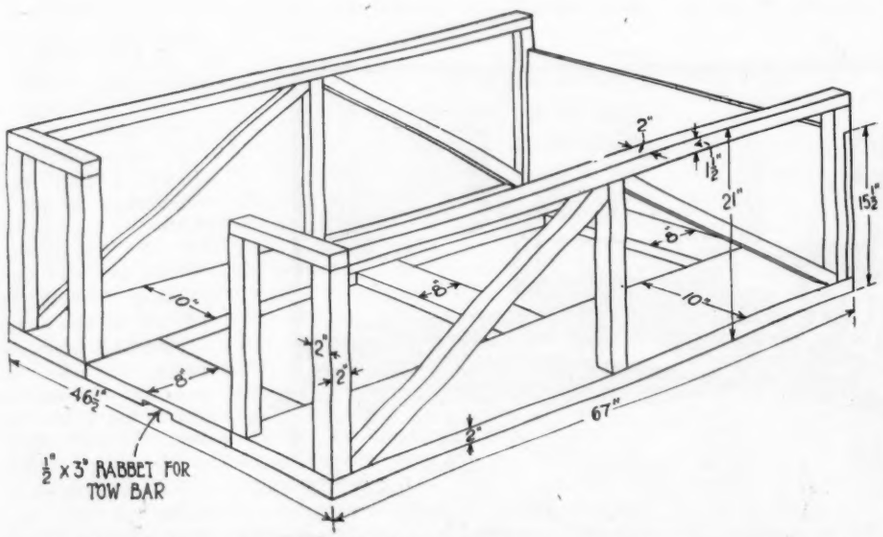
We show on these pages dimensional drawings that give all the necessary figures for building a tow car on the chassis of a 1916 Studebaker Six. This car was picked out simply because it was thought representative of those cars likely to be used for this class of service. The body which is shown here is one that can readily be adapted to any make of chassis and, of course, can be altered to suit conditions.

For instance, it might be desired to have a wrecking crane installed on the floor of the body. This can be done by leaving out the two rear seat compartments shown in these illustrations. The construction of the crane however, will dictate this. Some cranes are arranged so that they can be used in the shop and readily attached to the wrecking or tow car when needed for road work. Most dealers and maintainence men in the smaller towns state that they find a car as shown here adequate for most work. Such a car, with the aid of a block and tackle will pull a heavy car out of a ditch. In some localities, especially if concrete roads abound in the vicinity, it might pay to build a truck and fit it with a permanent crane. Such tow cars usually are built on the chassis of high powered cars.

The car shown is fitted with a body on which there are no curved pieces. The framework should be of ash, or some similar wood, and should be divided into two parts. One part takes in the space from the dash to the rear of the seat, and is covered with metal, while the remainder is covered with ¾ in. wood. The tow bar is essentially part of the chassis, the illustration showing its size and manner of fastening to the frame. The rear cross piece of the body framework is rabbetted to receive the tow bar and a few lag screws inserted through the bar and cross piece. This makes a very strong construction and relieves the side pull on the bar when a car is pulled out of the ditch and there is not a direct pull on the bar.



Framework for the forward part of the body. This is to be covered with metal. The lower illustration shows the body sill and method of constructing it

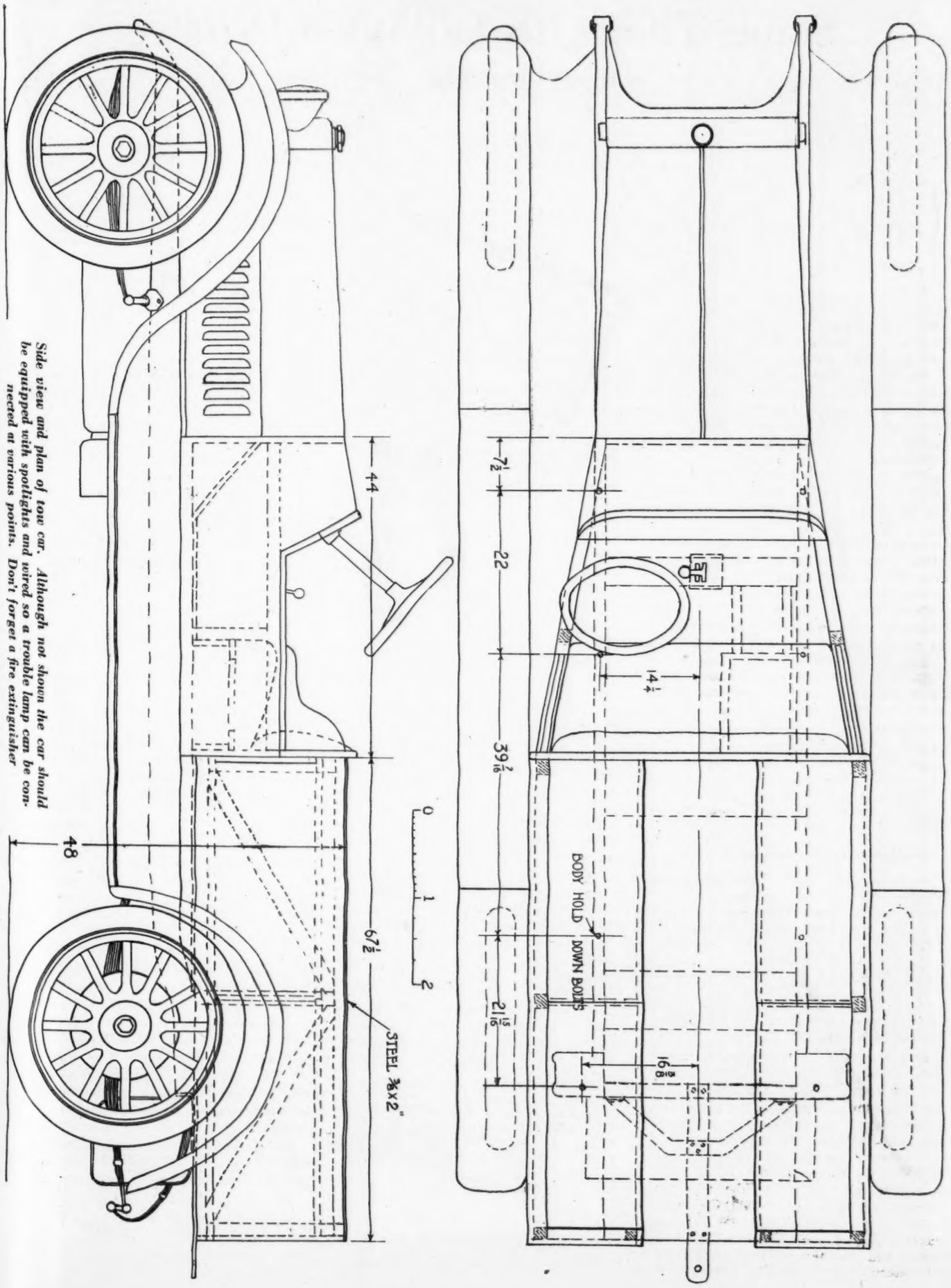


The framework for the rear part of the body. The pieces all are dimensioned, so little trouble should be experienced in getting out the wood. It will be well to reinforce the joints with angle and T-plates. This part of the body is to be covered with wood side panels

In the design here, the instrument board has been kept at the same point as in the original design of the Studebaker body. No doors are fitted to the driving compartment as a stronger construction is possible without them and comfort is one of the last factors to consider in building a tow car. However, along this line mention might be made that a windshield and cab could easily be mounted on this car for protection in cold, and rainy weather.

One thing should be borne in mind by the builder of this car, and that is to paint it attractively, say an orange and black combination, or something similar. The large side panels of the body offer a splendid place for the name of the establishment and other advertising matter.

We believe the illustrations, which have been drawn to scale, ample for anyone who intends building such a car. Any carpenter can construct the body and most shops have sufficient tools with which to do the work, providing one or



Side view and plan of tow car. Although not shown the car should be equipped with spotlights and wired so a trouble lamp can be connected at various points. Don't forget a fire extinguisher

Some Things to Do When You've Got a Little Time

There Are Many Important Things to Do in the Way of Getting Ready for the Spring Rush of Business

INSTEAD of sitting around and grouching about "no business" and cussing the cold weather and the price of coal, it might be well for many of our small town maintenance men—and the large city fellows, too—to take a sheet of paper and jot down some of the things they wished they had had on hand last Spring and Summer to help in getting the customers fixed up quickly.

Maybe you had wished for a better way of caring for your tools. They were scattered all about and when you wanted a wheel puller, the chief mogul only knew where it was. Maybe it was in the office, maybe in the shop, in somebody's car or loaned to a friend. Anyway, it could not be found. You swore up and down that this Winter you were going to make some sort of chest or cabinet in which to lock up this kind of stuff. The cold season is here now. Are you going to build that cabinet?

Or, maybe, you wished you had a tow car this Spring and Summer. In fact you could use one now. Are you going to build it this Winter? How about the wash rack? Wouldn't it be a good time now to build one? Does any of your shop equipment like the lathe or some other machine tool need rebushing and a general fixing up? You know best the things you would like to fix up in your place of business and why worry along through the Winter and then plunge into the Spring rush under the same conditions as before? Here are some of the things to think about:

1—Look Over the Machine Tools

Of course you want to keep busy this Winter with your regular shop work, but there may be times when there will not be a heavy demand for the various machine tools. If the headstock of the lathe needs rebushing, have it done at this time. Maybe the belt needs replacing. The lead screw may have become worn and need replacing. A check-up will reveal the parts that need renewal. Sometimes it takes a long while to get these from the machine tool makers, so don't wait until Spring to order them. Maybe the lathe and the other tools are still in good shape and need only a good cleaning. Probably you will want to make some new lathe tools. Or, now may be the time to build a wooden rack on which to place the tools, dogs and clamps while the lathe is in operation and the tools and fixtures have been removed from the tool cabinet.

Look over the arbor press, the drill press or the line shafting and see where repairs are needed. Maybe you were going to switch over from an old one-lunger stationary engine to an electric motor for driving the shop machinery. This is the time for it.

2—Installing Safety Devices

How about exposed belts in your shop? Are the fire extinguishers in good order, easily located and ready for emergencies? One thing you might do this Winter is to build a wood framework, cover it with wire netting and place it around the exposed belts which are likely to catch a workman unawares. One lawsuit may set you back as much as it would cost to equip your shop with individual motor-driven machinery.

Put the fire extinguishers on a post and paint red circles on each side of the post so that when a man looks for the extinguisher the red circles will tell him the posts on which the apparatus is fastened.

3—Make Tool Racks

In another part of this issue is shown the manner in which to construct a tool cabinet or rack. It takes but a few dollars' worth of wood, screws, hinges, drawer pulls and locks to make a tool cabinet and once you have it it is there for all time. The tools can be arranged orderly and when a mechanic wants any certain one he knows where to find it.

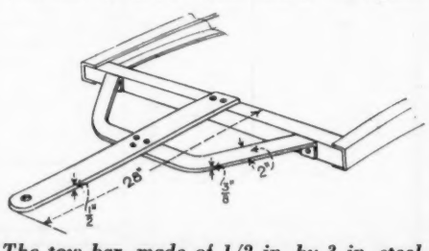
A cabinet or rack prevents shop leaks because it is easier to check up on a tool when there is a definite place for it. Look around the shop and see how your tools are kept. Maybe you will want to refer to the instructions for making the cabinet in this issue.

If you have an old car in your place

(Continued from preceding page)

two of the mechanics are carpenter enough to fit the parts together.

Run a band of steel about ⅜ in. by 2 in. around the top of the body to protect the edges. Very often heavy parts which cannot be placed on the floor have to be carried on the top of the body sides and the iron will prevent marring the surface. No attempt has been made to divide the compartments in the body. This can be left to the builder who can arrange things to suit conditions. The center aisle comes in handy for large jacks, a shovel, crow bars, maul, iron stakes, and similar apparatus often used for getting out a ditched vehicle. It might be well to make the floor boards of the body removable so that such parts as the brake levers and gearset can be reached for inspection, oiling or repair.



The tow bar, made of 1/2 in. by 3 in. steel. The hole is for a U-hook held in place by a 1/2 in. bolt

The plan view shows the layout of the hold down bolts on this particular chassis so that the sills can be laid out and the holes bored for the bolts without mounting the body on the frame though, usually, the sills have to be placed upon the frame and the holes spotted for drilling.

There are several suggestions for towing and wrecking cars in the illustrated section extending from page—to page—of this issue. From these and the plans given here, we believe little difficulty will be encountered in building a car that will meet the needs of most maintenance stations.

THE OUTPUT OF MOST
Back Up the Sale of Ele

A BATTERY NEEDS MORE CHARGING CURRENT IN WINTER

Because—

It is less efficient at low temperatures.

The engine is stiff with heavy oil, causing the starting motor to take more current from the battery.

Carburetion is poor and the starting motor must be operated for a longer time before the engine will start.

Additional equipment such as windshield wipers, hand warmers and electrical primers require extra current which the battery must supply.

It gets dark earlier and the lights are used more.

THE maintenance shop figuring on giving its customers 100 per cent satisfaction, will not only see to it that every legitimate means is used to equip customers' cars with modern electrical devices suitable for winter use, but will also see to it that these continue to give satisfaction. Such will be the case if the precaution is taken of boosting the charging rate to the battery, so that plenty of current will be available.

This is even necessary, as indicated above, if no extra winter equipment is added, and on most modern generators is easily accomplished.

On cars equipped with Remy generators having third brush adjustment and thermostat control, no change is needed, for the temperature automatically regulates the generator's action and keeps it operating at the high rate of about 18 amps., which is necessary in winter to keep the battery in approximately the same condition that 12 amps. would accomplish in summer.

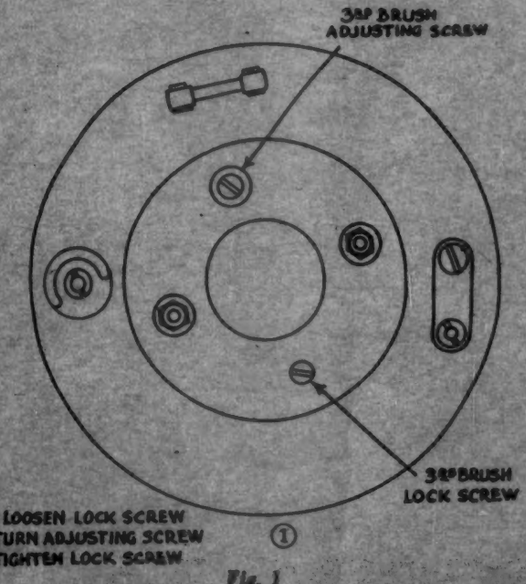


Fig. 1

North East Motor-Generator on Dodge

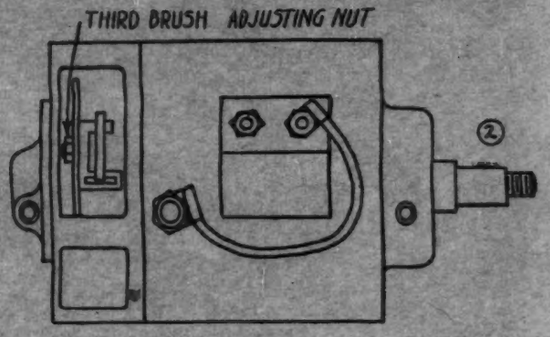


Fig. 2

Autolite generator on Chevrolet and Maxwell

Change in the third brush position can be accomplished, however, if necessary, by loosening a clamp screw on the end bracket. This permits pushing the brush to the required position, after which the screw should again be tightened.

On other types, however, it is necessary to change the output and while no absolute rule can be given, it will be found that the 12 amp. figure for summer and the 18 amp. figure for winter will be about right. On any individual car, however, the only real way is to take hydrometer readings occasionally and if the readings continually get lower, additional charging current is needed, while if the battery gravity is always around 1280, then a slight reduction might be tried. Even here, however, we may find exceptions, as, for example, where a physician might be using the car on very short trips, where the time that the generator would operate would be so short that no reasonable amount of increase would be able to make up for the current used. This would, of course, necessitate charging occasionally from some outside source.

Methods of Adjustment

The third brush method of adjustment is the one most commonly used, and it does not matter what the make of generator may be, the charging current can be increased if the brush is moved in the direction of rotation.

Detail construction on different makes varies somewhat as indicated in the various sketches. In Fig. 1, for example, the Northeast generator on Dodge cars can be adjusted by loosening one screw and turning another. In this construction the adjusting screw is part of a small pinion, which meshes with a sector, which carries the third brush holder. Turning the adjusting screw to get the desired output should, of course, be followed by relocking the clamp screw. On Dodge generators which charge a 12 volt battery the current could be as low as 5 amp. or as high as figure is used, it should be later weather or for very long trips.

The 6 volt generator made by on Reo cars is similarly adjuste screws instead of one. Being voltage, the current may be as

Ford Generator Has Clamp Nu

In Fig. 2 is shown the metho generators, used on Chevrolet Here it is necessary to loosen a sible by removing the commuta thin wrench, however, is needed construction is used on Ford ge house generators used on Stearn recent Bosch generators. With is necessary to push the brush position as the nut is used for only.

In Fig. 3, which shows the Hudson and Essex, the third br three screws, which must be l carries a sleeve which extends the third brush holder. A pin this third brush plate.

In Fig. 4 the Atwater Kent Packard single six is shown. He end must be removed to take cover. With the cover removed will be accessible. One is on th while the other is on the inside near the outer edge, so that it ca with a screwdriver. With thes brush can be pushed to any po

In Fig. 5 is shown the constru ployed on Delco generators. A the left, while at the right, ju bracket, is a screw, the end o washers which push or pull a pr brush holder plate. Turning th

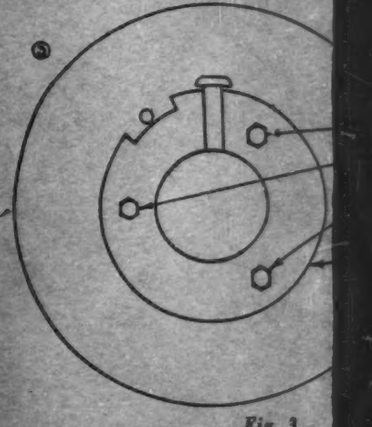


Fig. 3

Bosch generator on Hude

OF MOST GENERATORS CAN BE
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as low as 5 amp. or as high as 10, but if the latter figure is used, it should be later reduced for warmer weather or for very long trips.

The 6 volt generator made by Northeast and used on Reo cars is similarly adjusted, but has two clamp screws instead of one. Being designed for lower voltage, the current may be as high as 18 amp.

Ford Generator Has Third Brush Clamp Nut

In Fig. 2 is shown the method used with Autolite generators, used on Chevrolet and Maxwell cars. Here it is necessary to loosen a nut which is accessible by removing the commutator cover. A special thin wrench, however, is needed. This same type of construction is used on Ford generators, on Westinghouse generators used on Stearns cars, and on some recent Bosch generators. With this construction it is necessary to push the brush holder to the desired position as the nut is used for locking in position only.

In Fig. 3, which shows the Bosch generator on Hudson and Essex, the third brush plate is held by three screws, which must be loosened. The plate carries a sleeve which extends inward and carries the third brush holder. A pin limits the motion of this third brush plate.

In Fig. 4 the Atwater Kent generator on the Packard single six is shown. Here two screws in the end must be removed to take off the commutator cover. With the cover removed, two other screws will be accessible. One is on the outside at the left while the other is on the inside of the bracket, but near the outer edge, so that it can easily be loosened with a screwdriver. With these screws loose, the brush can be pushed to any position desired.

In Fig. 5 is shown the construction commonly employed on Delco generators. A clamp nut is seen at the left, while at the right, just inside the end bracket, is a screw, the end of which carries two washers which push or pull a projection on the third brush holder plate. Turning the screw one way or

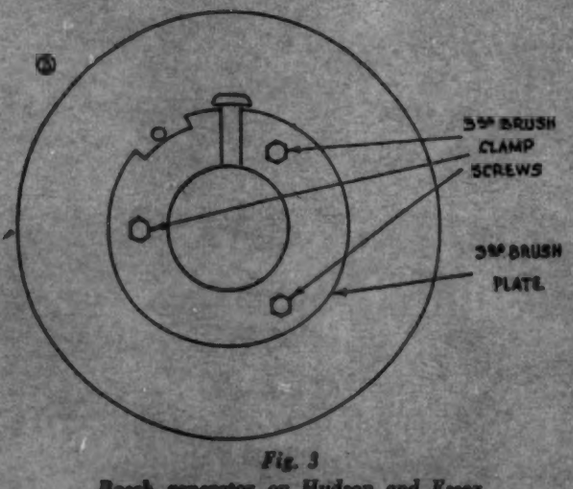

Fig. 3
Bosch generator on Hudson and Essex

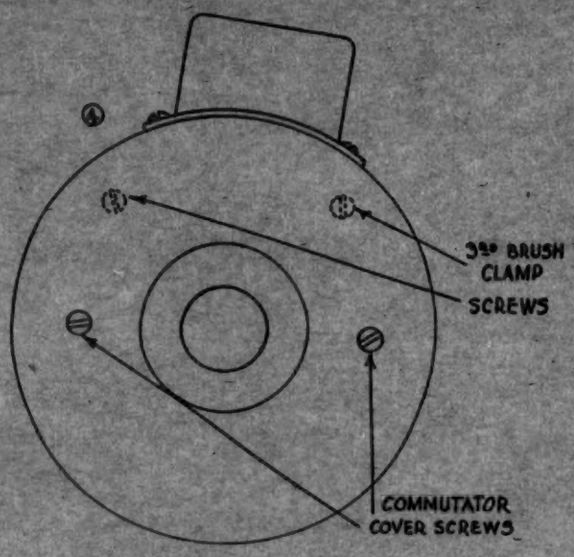

Fig. 4
Atwater Kent generator on Packard

the other, therefore, makes possible any desired adjustment.

On the Dyneto generator, shown in Fig. 6, the clamp screw is supposed to be concealed by a leather plug in the end bracket, which is intended to hide the adjustment, to prevent its being tampered with by incompetent persons. The Simms Huff scheme shown in Fig. 7 is a type often encountered, adjustment being made by loosening the nut and pushing to the desired position.

In Fig. 10 is the construction used on Delco motor generators on Lincoln cars. A clamp nut is used at the outside of the end bracket, but as this is not accessible when on the car, it is so designed that it

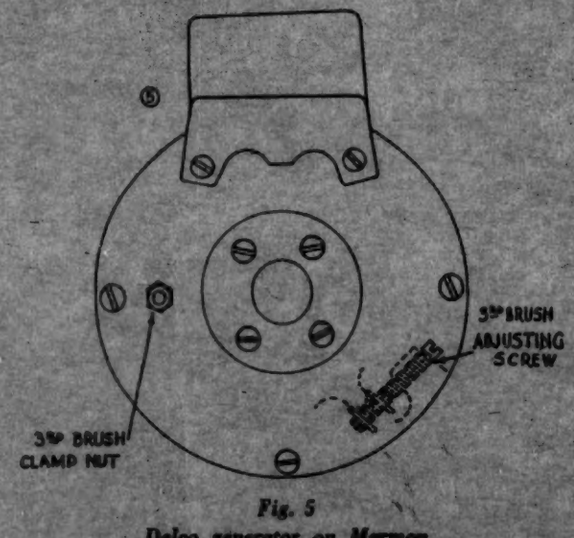

Fig. 5
Delco generator on Marmon

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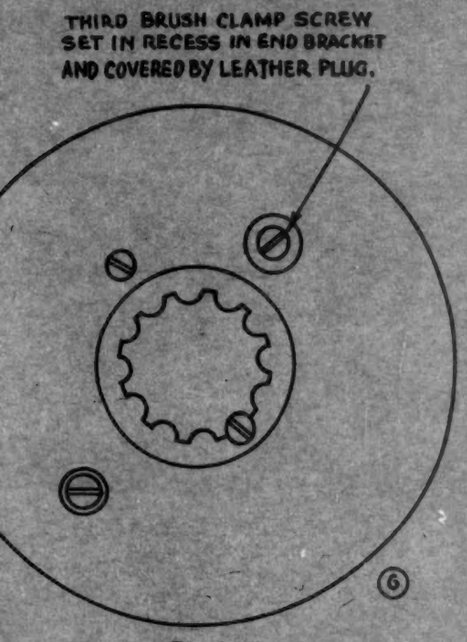

Fig. 6
Dyneto generator

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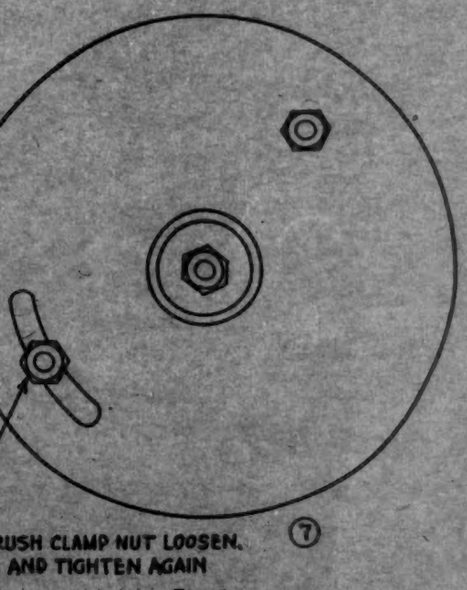

Fig. 7
imms Huff generator on 1920-21-22 Maxwell

The Bucking Series Type Generator

Many generators in service on cars today are not of the third brush type and the charging current is more or less a fixed quantity, depending on the speed at which the car is operated and on the original design characteristics of the machine. To prevent excessive current to the battery at high engine speeds a series field winding is used, through which the charging current must flow, and the magnetic effect of this winding opposes or bucks that of the shunt field.

This inherent regulation can be varied somewhat, however, by shorting or partially shorting the series winding. This method of increasing the charging current is illustrated in Fig. 8, where a Westinghouse generator is shown with a jumper connected across the series field terminals. In this machine the current to lights comes directly from the brush, while current for the battery is led through the bucking winding. The resistance across the "B" and "L" terminals will, accordingly, allow some of the current to get to the battery without going through the series winding, and the reduced bucking effect will permit a greater output from the machine.

As with other changes in generator output, this should be done with discretion and with due regard for the way in which the car is being operated, the maximum charge being obtained when the jumper is a heavy piece of copper wire, while a more moderate increase can be obtained by an iron or German silver shunt of slight resistance.

The Vibrating Regulator

Control of current output on several makes of generators is by means of a vibrating regulator. This control is based on the operation of a pair of contacts across which a resistance is connected. This pair of contacts is then located in series with the shunt field of the machine so that opening of the points will put the resistance in series, reduce the field current and hence the output of the generator.

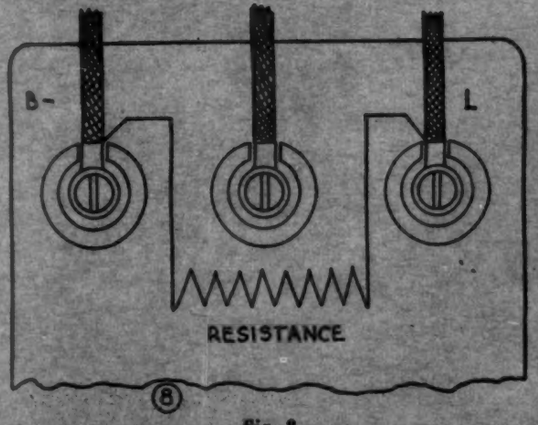

Fig. 8
Westinghouse generator with reverse series field

These contacts are normally held together by spring action, and are opened by magnetic action produced by a winding affected either by the voltage or the current output of the machine.

In practice, regulators of this type usually have two coils, one a voltage coil and one a current coil, as this has been found to give the most satisfactory operation. The extent of the regulation at high speed depends on the value of the resistance that is connected across the contacts, a high resistance holding the output to a predetermined figure at higher speeds than a lower value of resistance. On the other hand, the lower the resistance the less will be the sparking at the contacts, and the longer their life. In some types of regulators condensers have been employed connected across the points to minimize the destructive action which the sparking produces.

In Fig. 9 is shown a Bijur regulator such as has been used on Packard cars. This is made both as a current and voltage regulator, heavy turns of wire on the right hand coil indicating the current type.

To increase the charging current for winter use, it is necessary to increase the spring tension, which causes the output to rise to a higher value before the magnetic action is enough to neutralize the spring

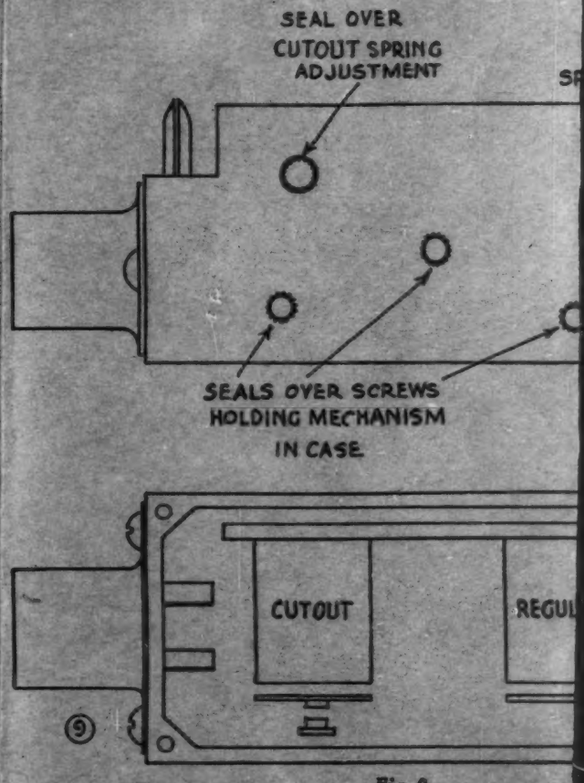

Fig. 9
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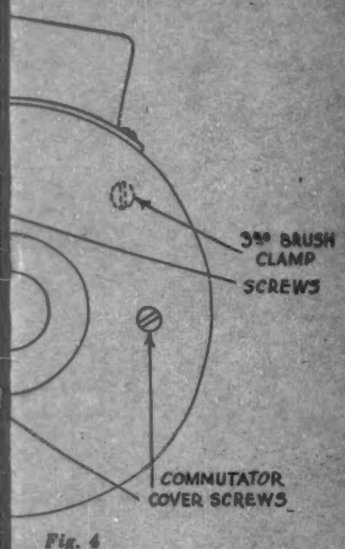

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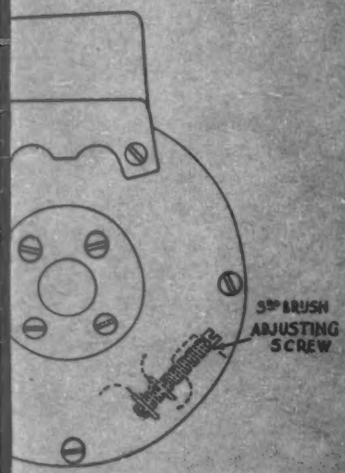

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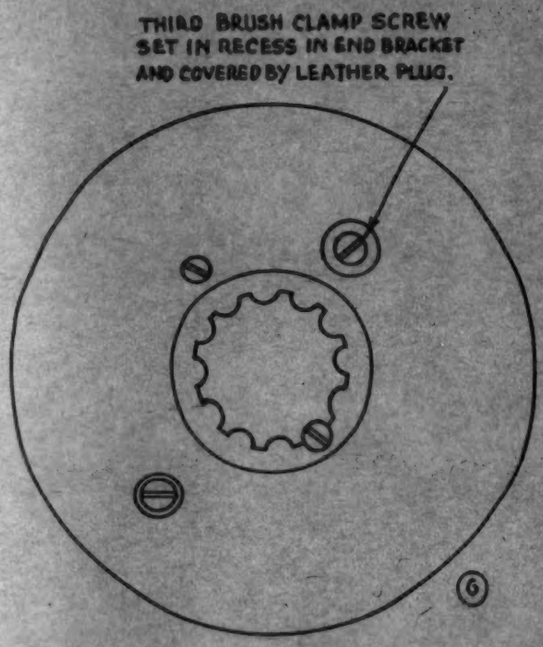

Fig. 6
Dyneto generator

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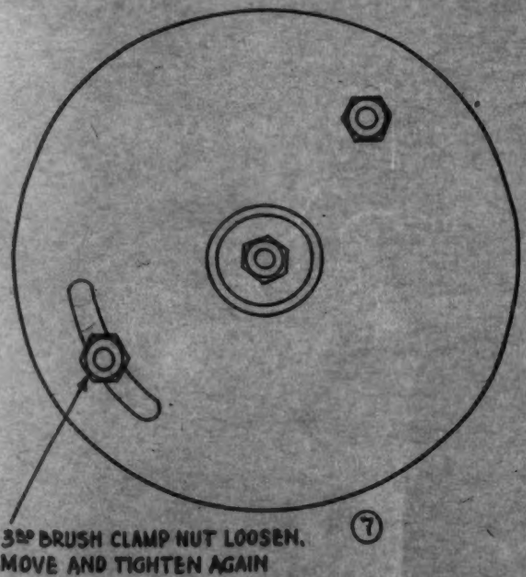

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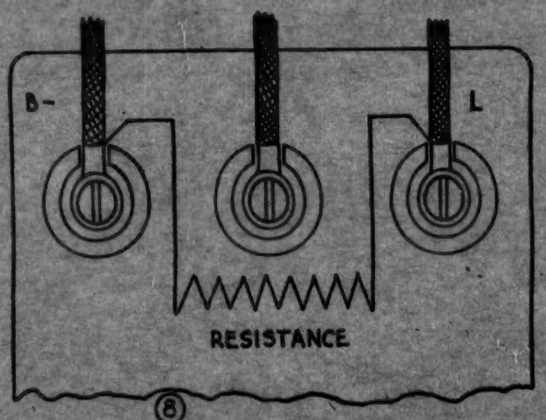

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INTER NEEDS
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In Fig. 9 is shown a Bijur regulator such as has been used on Packard cars. This is made both as a current and voltage regulator, heavy turns of wire on the right hand coil indicating the current type.

To increase the charging current for winter use, it is necessary to increase the spring tension, which causes the output to rise to a higher value before the magnetic action is enough to neutralize the spring action and make the points vibrate. To adjust the output it is necessary to remove the seal and screw plug at the back of the regulator and insert a special socket wrench, or else take off the top cover and push the ratchet wheel around with a small screw driver.

With current regulators the ammeter can be observed to see the extent that the charging current is being raised, while with voltage regulators the ammeter can also be used, the maximum current being correct for a well discharged battery. As the battery on the car may not be in a discharged condition, this state can be imitated by operating the starter, then quickly starting the engine, and observing the charging current quickly before it drops off due to the rising battery voltage.

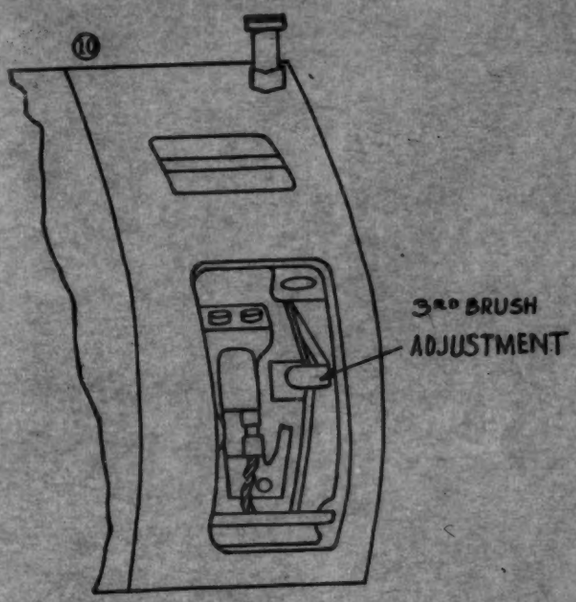


Fig. 10

Delco generator on Lincoln

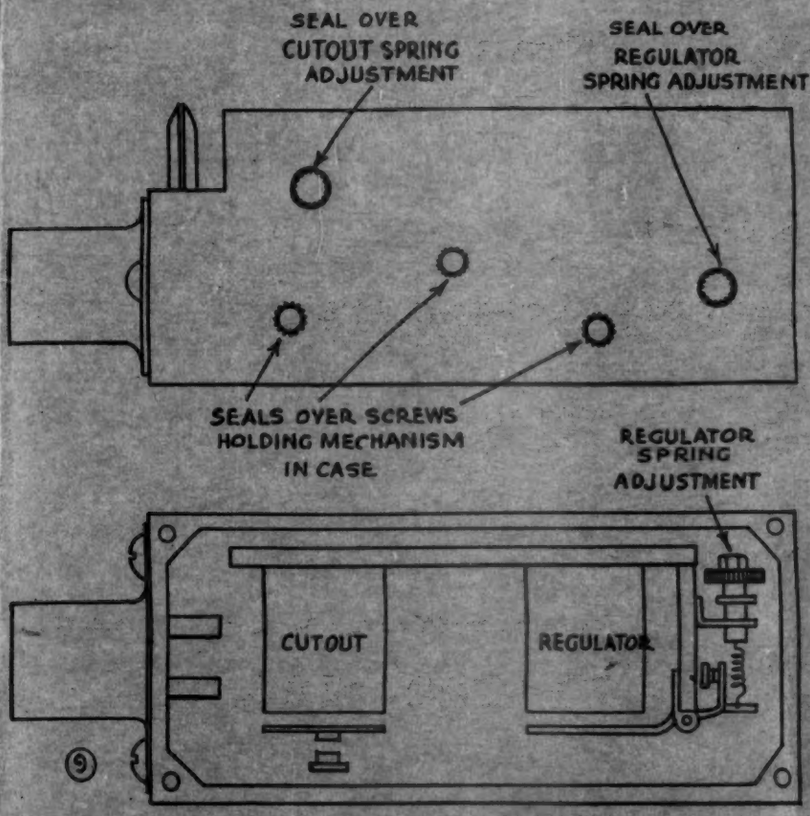


Fig. 9

Bijur voltage of current regulator used on Packard car

that would make a good tow car or wrecking truck, why not rebuild it into one? Of course, it is essential that the engine, axles and other major units of the car be in good condition. As in the case of the tool cabinet, full instructions for making a tow car are given elsewhere in this issue.

4—Building a Tow Car

Certainly it is good business to convert a fairly good old chassis into a tow car, rather than to let such a chassis stand around waiting for a buyer. No one, unless he is going to do a wrecking business only, will buy a new chassis for a tow car. Invariably such cars are converted from old models, which, while they may have lost out so far as body styles are concerned, still can "pull like the devil," as a maintenance man recently said about an old Jeffery which he had built into a tow car.

5—Making a Wash Rack

We often lose sight of the fact that there is considerable maintenance work to be done in connection with the body and fenders of a car in the way of preserving the finish. When your customer says to you after he has told you what repairs he wants made, "Give her a wash and polish, too," are you able to take care of the job?

A customer is far more apt to appreciate a good mechanical job on his car when he gets the latter all spic and span after a wash and polish. Very often an otherwise excellent repair operation is nullified because of a dirty car and the shop has to make the excuse that it does not do washing or polishing.

Some of the better class wash racks these days use air pressure in connection with the water. If you have the space for a rack and are contemplating building one, watch for the article telling you how to go about the job. It will appear in an early issue.

6—Covering the Bench Top

In the better class shops the top of the workbench is almost always covered with sheet metal, usually zinc. Maybe you have a bench now, the top of which is built from 2-in. planks butted together and the surfaces of which are so oil soaked and dirty that you hardly know they are wood. Clean them off with hot soda and then cover the top with metal. Such a top is easy to clean, looks better, preserves the bench and makes for better work all around.

7—Piping the Bench for Gas and Air

Did your mechanics have city gas available at their bench this Spring and Summer to heat parts and soldering coppers? And, did they have to blow their lungs out to get chips and filings from units on which they worked? Possibly the only air line you have is the one out in front for the free air service.

Better work is possible and many operations will be speeded up if gas and air are piped to the bench and a lead taken from each at regular intervals on the bench. It is a help to the men to be able to plug in an air hose at most any point, or to turn on a gas flame. The same is true of electric current. There should be receptacles at regular intervals on the bench for the men to plug into with the trouble lamps. The directions for making a bench in this issue go into detail on this.

8—Clean House

Many times all a shop needs is to clean house. Take a look under the workbench of most any shop and see the amount of junk collected there. It would pay to move everything out and scrub the floor, repaint the walls, benches, window sills, etc., wash the windows, provide a box with a cover on it for collecting junk and then see to it that everything stays neat and clean. If you do the things mentioned before and then clean house, you will be in pretty good shape to tackle next year's busy season.

Lack of Proper Education of Car Owner Has Been Big Reason for Winter Slumps

Winter, sometimes called King and at one time the fearsome enemy of the motor car, is now veritably the laughing stock of the town. There was a time when even the thought of operating a motor vehicle consistently in zero weather was looked on with the same curiosity as the chronic bather who makes his trips to the beach when the beach sand has given the right of way to snow and ice. Nothing radical or phenomenal has since taken place, nevertheless the winter operation of a motor vehicle is an item of far less curiosity to the public than the sight of a horse and wagon on any city street. Motor vehicles, both pleasure and commercial, are now year 'round modes of transportation, and gasoline has demonstrated that it can move merchandise and humanity with at least an approximation of consistency.

Creature Comfort Problems

Disregarding the problems of creature comfort, the greatest impediment to the year 'round use of motor transportation has been due to lack of facilities and education regarding the proper preparation of the vehicle to enable it to burn fuel. Creature comfort has been accomplished by the intelligent design of bodies that provide protection from the worst that Winter can offer. Preparation of the vehicle to enable it to utilize the fuel in cold weather has been accomplished quite satisfactorily by the various electrical vaporizers and engine operated hot spots.

However the efficiency of all vaporizers presupposes that the correct grade and quantity of fuel be present in the carbureter.

To insure the functioning of the various primers and vaporizers, it is advisable to take such steps as will provide this insurance. It is best done by starting at the source of the fuel supply which is at the tank. First: Be sure that the tank is adequately protected against the entry of water which will form from the melting of snow or ice, on the tank. The gas tank gage, if located on top of the gas tank, is a possible point of leakage. Make sure that the gage gaskets and glass are intact and that the tank cap vent hole is not unnecessarily exposed. The sediment bulb should be drained frequently during Winter.

The Sediment Bulb

The gas line from the tank to carbureter is equipped with a strainer or, perhaps, a sediment bulb some place in the circuit. The best gasoline contains a small quantity of moisture which it precipitates if exposed to varying temperatures. The moisture in the gasoline is most pronounced in Winter and consequently the strainers and sediment chambers are called on to do more work than in Summer. If the precipitated moisture is allowed to collect in the strainer it will freeze and eventually obstruct the fuel line to the carbureter. This freezing may occur while the vehicle is being operated or while it is standing and is sometimes difficult to diagnose. The settling chamber of the vacuum tank is another favorite gathering place for water resulting from condensation, and an overtaxed strainer. The vacuum tank sediment chamber, which is located at the extreme bottom of the tank, and any strainers or sediment bulbs in the line between supply tank and carbureter should be drained regularly at weekly intervals. If these are drained regularly it will not be necessary to frequently drain the carbureter strainer which is the last strainer in the line between tank and engine. Should the strainer in the carbureter become obstructed, it is an indication that the vacuum tank sediment chamber and possibly the supply tank strainer are in need of cleaning or draining. The presence of water in the carbureter will prevent starting because of its great density which prevents it being drawn through the small orifice of the carbureter nozzle.

How Should Engine Bearings Be Fitted?

Alignment and Circularity First Requirements: Time Saved by Using Mandrel

By PAUL DUMAS

ONLY of recent years has the manufacturer given maintenance the consideration to which it is entitled. Perhaps this lack of consideration was due to the fact that the factories were fully occupied with the problems of manufacturing the product and being so occupied, their horizon extended only as far as getting the vehicle into the hands of the factory agent. It is reasonable to believe this, because of the trend of events in the industry during the past eight years.

The Tendency of the Times

Since very decided improvements have been accomplished in production methods. The car makers have acquired a farther and clearer vision regarding the ultimate status of their product. They have seen that ultimately the mechanism of the best constructed vehicle will wear and be subject to damage through accident. Some of them are now taking measures that will enable the agent to execute maintenance operations with some semblance of certainty. Certainty of mechanical results achieved works hand in hand with certainty and uniformity of the price charged the car owner.

It is unnecessary to state that everyone wants more certainty in maintenance prices even though uniformity of these charges must vary some with the different geographical locations and the different makes of vehicles being serviced. The manufacturers therefore, with the widened vision, are applying the methods of approved factory production with the necessary modifications to that part of their organization that is occupied in servicing the vehicle.

The bearings of the motor vehicle have come in for a great amount of attention from the maker of the engine and for this reason production has been increased as much as 60 per cent in the average plant on the same money outlay. Coupled with greater output, a better product has also resulted. The labor required to maintain the engine bearings for a given mileage has been decreased by an average of 40 per cent of the time required for their maintenance eight years ago.

No single item, however, is responsible for the better production and better performance of the engine bearings, because both have been secured only after a thorough and painstaking study of the factors involved.

To the maintenance station with limited facilities the adoption of factory methods of bearing maintenance may seem impossible. It is unreasonable to think that the small service station will ever be able to duplicate the factory methods of maintenance but it is reasonable to believe that, if the maintenance operators have a thorough knowledge of factory methods, they can apply the principles of those methods and that portion of the factory procedure which is applicable to their individual institution.

Decline of the Hand Scraper

It may be worthy of mention here that the modern methods of factory production, especially in regard to engine bearings, have brought about a marked decrease of the demand for a once popular tool, the hand scraper or bearing scraper as it is sometimes called. In the maintenance division of the industry we believe that the marked falling off in the use of the hand scraper is an indication of the present trend of manufacturing and maintenance endeavor. The hand scraping method of fitting engine bearings is by no means obsolete, nevertheless the scraping method is either a preliminary or a finishing operation while the bulk of the work is taken care of through the use of labor saving tools and machinery.

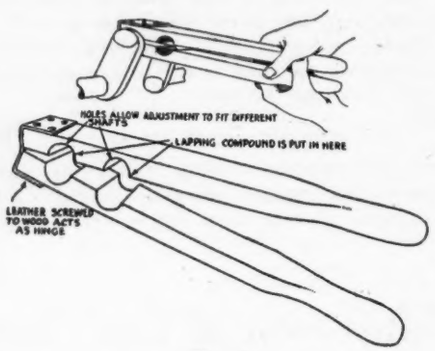


Fig. 1
Even new shafts are lapped at the journals before fitting

The results achieved by the automobile factories have not been due entirely to the labor saving equipment but to a cooperation between the designing department and the production department. In many cases the designs of the cars and engines have shown considerable revision, from the original layout, to adapt the job for quantity and quality production.

Makeup of a Bearing Assembly

The reviewing of factory methods and changes in design is a long story in itself but, if we bring to mind the specific parts of the engine that are unconsciously visualized when we think of engine bearings, we can realize the effects of this development. Specifically, the units that go to make up a bearing assembly in the conventional type of motor vehicle engine are the **crankshaft,** the **crankcase,** the **connecting rod** and the **bearing metal.** If we briefly review the manner of design and manufacture of the units mentioned as they are used today and compare them with the practices of the past it will enable the reader to secure a clearer conception of the present trend in engine building and its application to the maintenance business.

The Crankshaft

The engine crankshaft of the present day engine does not differ radically in design from the crankshaft as used eight years ago. The shaft, generally speaking, is superior, especially from the standpoint of bearing life, and the life of the engine as a whole, on account of the much better running balance imparted it by the modern dynamic balancing machine. The general quality of the workmanship on the present day crankshaft is considerably higher than on those of the earlier period. The dimensional tolerances are closer and the finish of the journals is smoother. Even on the large production jobs the main bearing crankshaft journals are held to .001 inch diametrical tolerance. The inspection demands of the modern engine factory on crankshaft manufacturers and especially organizations engaged in the finishing of rough forgings, has raised the standard of workmanship. Because of the necessities of production and to provide interchangeability, it is common to reject a crankshaft which is .001 undersize or .001 oversize of the specified diameter on any one of the bearing journal pins.

Journals and pins are lapped in addition to being ground, a comparatively insignificant operation but having pronounced effect on bearing reliability. Grinding leaves the metal with an apparently smooth surface but microscopic examination shows very small, yet pronounced, irregularities of the surface. These minute irregularities are sufficient to show their effects on the friction coefficient of the bearing and are not inducive to long life of the bearing. By maintaining the smoothest possible initial finish of the journals it has been found that the safe initial clearance between shaft and bushing can be materially decreased. Lap tool shown in Fig. 1.

The wide spread trend towards drilled crankshafts providing pressure lubrication, no doubt has been a large factor in the long life now secured from main and connecting rod bearings. The

efforts on the part of one or two prominent American firms to secure the maximum engine life has accounted for the use of case hardened journals on the crankshaft by these concerns. A view of of a representative crankshaft showing the manufacturer's specifications is shown in Fig. 2.

The Crankcase

Crankcase design has undergone some revision during the past few years as it has been found that the design of the crankcase has not only a direct bearing on the life, but also on the smoothness of the engine. Some engine designs necessitated that the rigidity of the crankshaft be depended on to add rigidity to the crankcase, but the present trend seems toward crankcases which are of themselves sufficiently rigid to withstand all torque strains, and such as are transmitted from the chassis frame. Besides contributing to the smooth operation of an engine, through reducing vibration at certain speeds, a rigid crankcase permits of rapid production in regard to bearing fitting. There are a few engines manufactured today which require that the cylinder block be mounted on the crankcase before the bearing machining operations are completed. A change in the section shape and the addition of strengthening webs in the separately cast crankcase have added the rigidity that enables all machine operations being finished before attachment of the cylinders.

The machining of the bearing seats in crankcases is now done in much less time and with greater accuracy. Where removable bushings are used for the main bearings the seats are either milled, bored or ground, depending on the standard of the engine manufacturer. In the cases where the main bearings are cast into the cylinder or crankcase casting, the seats are not given such accurate

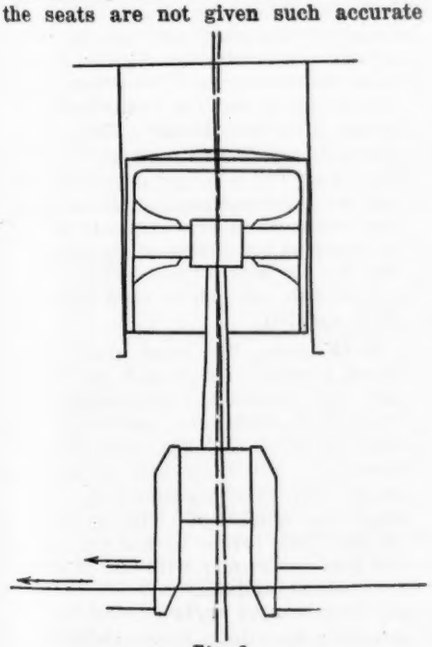


Fig. 2
Exaggerating condition produced by end play in crankshaft or bent connecting rod. Puzzling cases of oil pumping can be traced to this condition

machining and are usually finished by boring or milling.

Little change has been made in the design of connecting rods and connecting rod bearings, although the methods of fitting the lower end of the connecting rod to the crankshaft have undergone considerable change. As to whether the bearing metal shall be removable or permanently cast in the rod there is much diversity of opinion but within the last two years a few manufacturers have abandoned the removable type of connecting rod bushing and have adopted the cast in type, of babbitt bearing.

When the lower end of the rod carries a removable bushing, the seat in the rod and cap for this bushing is more carefully prepared than where the metal is cast into the rod. It is desirable to have 100 per cent contact between the back of the bushing and its seat in rod and cap. Lack of good contact at this point permits pounding down of the bearing, due to the blows transmitted by the pistons, the result of which is an increase in the diametral clearance between the crank pins and bushing, producing cracked bushings or looseness, that necessitates the bearing being adjusted a few months after being fitted. A good contact between the bushing back and the seat in the rod and cap also is necessary in order to provide an easy path for heat conducted from the piston head.

Bearing Bushing

In the phraseology of the bushing manufacturer, bearing bushings are either full half bushings or eccentric half bushings. The full half bushing is a full solid bushing which after being split is machined out on the inside, so that the inside diameter of the halves, when placed together, is a true circle. The halves are also chucked and a cut taken off of the outside diameter which makes it a true half bushing as shown in Fig. 4. There are no outstanding mechanical advantages connected with either type of bearing and from a standpoint of bearing reliability there is little to choose between them.

The service man can detect the presence of a full half bushing by the fact that usually only a few thin shims are provided between the cap and case and in some engines the bearing layout is such that no shims are used in either the main bearings or the connecting rod bearings. The use of an eccentric bushing is indicated by the fact that there will be interposed, between cap and upper half bearing on each side, a shim of at least 1/32 in. thickness.

The grooving of the bearings has received considerable study in recent years and the choice of the majority of manufacturers has been concentrated on a few well worked out designs which have replaced the many fantastic and almost useless designs of former years. Oil grooves are omitted on some pressure systems. Two types of grooves which

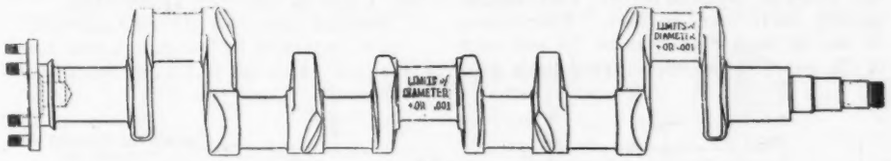


Fig. 3
The taper and eccentricity of any journal must not exceed .001. All journals must be lapped to mirror finish

are widely used are shown in Fig. 5.

Efforts to secure permanent anchorage of the bearing bushings halves in the cap and crankcase has led to the adoption of cast-in bearings in some few cases. Another method, commonly used to prevent rotation of the bushing, utilizes shims that are wide enough to exert a pressure on the bushing half, when the cap is drawn down. Locking screws which secure the bushing to its seat are also widely used either without the retaining type of shim or in conjunction with it. For some reason the dowel or key method of preventing rotation by the bushings has never found favor with manufacturers. The S. A. E. standard babbitt metal and the Fahrig are widely used for the connecting rod and main bearing lining and when in doubt as to the most suitable metal the maintenance operator will make no mistake in specifying either metal for bearings to be repoured.

The great accuracy now obtainable in bronze backed bushings provides an opportunity for the car and engine manufacturer to co-operate with the maintenance man. Bushings are often shipped for replacement that are as much as .040 undersize, to bring these to size, requires the removal of .020 of babbitt from each half. The maintenance operator must spend considerable time in this operation even if he is equipped with a line reamer because such an amount of stock can not be removed at one setting of the reamer, and if a lathe is not available, he is forced to hack away with the hand scraper until the bushing has been reduced to a size where actual fitting may begin. If the shaft has been reground and requires undersize bushings, the maintenance man can specify the extent of the undersize and the bushing can be shipped with an allowance of .005 or .006 stock for scraping to size and fit.

Analysis of Present Factory Methods

We have previously stated that the once popular and widely used hand scraper has lost favor especially among the automotive vehicle manufacturers. To substantiate this claim MOTOR AGE has made an analysis, based on factory information, of the factory methods now being used for machining, adjusting and fitting of the connecting rods and main bearings. The data contained in this

analysis represents the practices of 39 car manufacturers who make their own engines and eight companies engaged exclusively in producing motor vehicle power plants.

The 1922 passenger car chassis specifications printed in Automotive Industries, Feb. 16, 1922, show 52 passenger car chassis manufacturers who manufacture their own engines. Thirty-nine of the 52 manufacturers or 75 per cent of the concerns manufacturing their own engine, have supplied this data. These specifications list a total of 125 manufacturers and assemblers who produce one or more different chassis. With 52 manufacturers making their own engines, there remain 73 firms who buy their engines. The output of 50 of the 73 assemblers who buy their engines outside is represented in the analysis by the eight makes of engines included in this data. Of the total list of 125 manufacturers, therefore the data printed here cover 89, or slightly more than 71 per cent. The analysis may be considered as covering practically the entire field because of the fact that practically all of the manufacturers listed in the specifications, but not included in this data, are firms manufacturing medium and low priced cars in very limited quantities.

There are six general methods of bearing fitting used among the 89 firms as follows:

First—Bore or fly cut, and line ream only, on the main bearings. Bore, broach, and line ream only on the connecting rod bearings. The hand scraper is used only to touch up the ends or fillets of the rod and crankshaft bearings. Connecting rod bearings are given a burnishing operation to impart final finish.

This method has more adherents among manufacturers than any of the other five methods commonly used. It is used by five of the large engine companies, including such firms as Buda, Continental, Falls, Waukesha and Wisconsin. Of the 16 car manufacturers, whose bearings are fitted in this manner, 4 are in the over $4,000 class.

Second—Bore or fly cut and line ream, followed by hand scraping for surface finish on the main bearings.

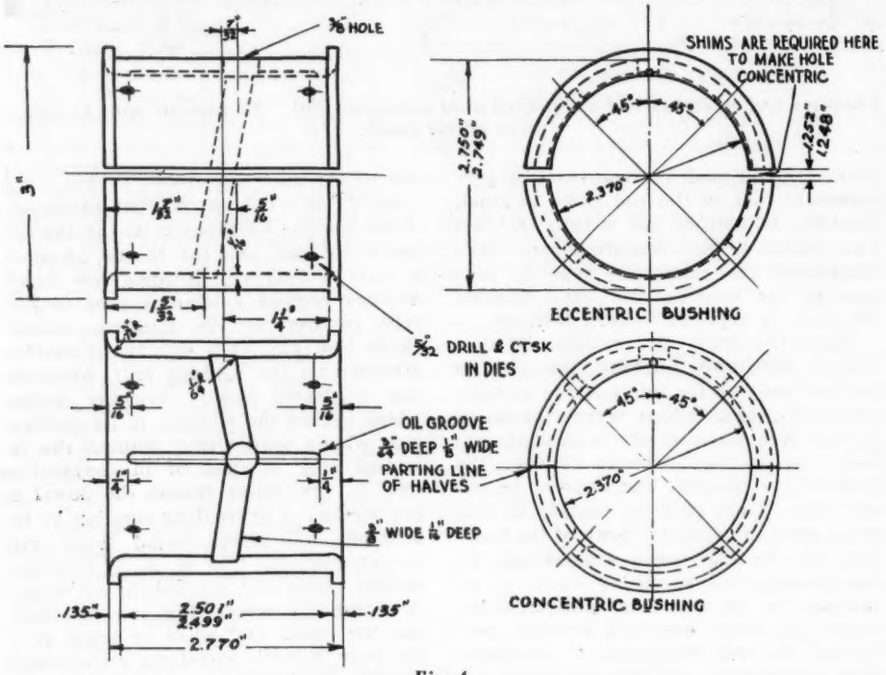


Fig. 4
The eccentric bushing is not machined after being split. The concentric type is more expensive to produce and is seldom used with shims

Bore or broach, ream, and finish surface by hand scraping or connecting rods.

Three of the firms which manufacture their own engines and use this method are in the over $4,000 class.

One engine manufacturer is included in the list of 13 adherents to this method.

Third—Bore, or fly cut, followed by hand scraping, no line reamer being used on the main bearings. Bore or broach followed by hand scraping only, on the connecting rod bearings.

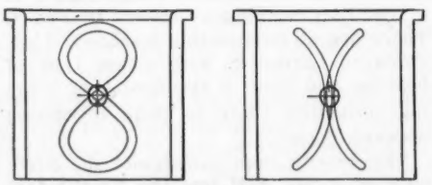


Fig. 5
Two easily produced and efficient types of oil grooves. The shimless connecting rod bearing usually is made for pressure lubrication and is grooveless

Two car manufacturers and one engine manufacturer are listed as using this method.

Fourth—Main and crankshaft bearings holes with caps installed are rough bored, then semi-finished bored, leaving about .008 for finishing cut which is done with single point tool having a diamond insert. Bearing shells are installed in finished hole (no liners or shims being used) in cap and case. Caps are bolted down and are finished cut by same process using single point diamond insert tool. The same method is followed with the connecting rods except that the rod holes or bearing seats are ground to a specified diameter instead of being bored, the joint faces of rod and cap are then lapped to form the joint. The bearing bushings are inserted and finished in a fixture with a single point diamond insert tool.

Two car manufacturers, both in the over $3,000 class, use this method. Very similar to method No. 5. Bearings may be replaced in the field without hand fitting.

Fifth—A new method which combines some of the features of the four methods mentioned except that the hand scraper is not used on the bearings themselves, although the bearing seats are sometimes hand scraped. The first operations consist in preparing the seats or holes in the case and lower end of connecting rods. It is necessary that the case and rod holes be accurately finished and for that reason several different methods are being used at present. The holes or seats for bearings are either bored, line reamed, fly cut, or ground.

Some firms line ream and hand scrape the case holes, another firm grinds these holes and a third manufacturer uses the single point diamond insert tool. The bearing bushings are made by a special method and are held to very close tolerances, especially the inside and outside diameters. After the case holes have been finish-machined, the bearings are installed and the crankshaft is bolted down permanently. The bushings that permit this method of bearing fitting are a recent development and are interchangeable. It is said that replacement of bearings in service work is accomplished by removing the old bearing and pressing in a new one, the job is then considered complete.

Sixth—Bore, line ream and burning-in process. Crankshaft bearings are line reamed to approximately crankshaft diameter, crankshaft is then installed and the caps bolted down after which the case is placed on the burning-in machine and given about one minute of running, without oil. This serves to flow the babbitt into conformity with the crankshaft shape and leaves a 90 to 100 per cent bearing surface. The main bearings are then given about 20 minutes of running in after which the connecting rods are put through the burning process in the same manner.

Sequence of Operations Method No. 1

The line reamer and burnishing method is the most popular among manufacturers at this time. The sequence of operations in using this process of fitting is as follows: The crankcase bearing holes or seats are machined to a specified size, either by boring, flycutting or reaming.

The bearing bushings are installed in the case and cap.

Bushings are filed flush with cap and case.

If the bushings are of the eccentric style, a thick shim is added on each side to make the inside bore approximately circular. These shims are usually about 1/32 in. thick.

Adjusting shims of from .0015 to .004 thickness are added to the thick shim on each side to permit adjustment later as wear occurs. The main bearing caps are bolted down. The first operation of preparing the babbitt surface follows. This operation may be boring or flycutting.

During the flycutting operation, case is centered by camshaft bearing holes. (The flycutter bar proper is similar to a long boring bar (Fig. 6). It is about .001 smaller in diameter than the inside diameter of the bushings. The car is fitted with one or more (usually one for each main bearing) cutters or tool bits which are adjustable by means provided for moving them out from the center of the bar.) Diamond insert tools are finding favor for use on the flycutter. The bar is considerably longer than the crankcase and being just slightly smaller in diameter than the inside bore of the bushings, a pilot effect is secured. The rod extends the full length of the case before the cutters are brought into action.

The bar is set to cut to a diameter about .002 smaller than the crankshaft diameter so that enough stock is left for the subsequent line reaming operation.

Flycutter is run through all bearings. Line reamer is set to about .022 larger than the crankshaft diameter. A pilot or guide is provided on the reamer for each bearing to insure alignment. Rotation of the line reamer is accomplished by hand or by the use of a portable pneumatic drill, fitted with a suitable chuck for holding reamer. (Line reamer is run through all bearings.)

Bearing caps are removed.

(A .002 shim is removed from under each cap.)

Shaft is laid in case.

(A coat of Prussian blue or lamp black is applied to each man bearing journal.)

One cap is bolted down and crankshaft is rotated a few times by hand to test for tightness.

Fitter removes a cap to observe amount of bearing surface on cap, and case. Hand scraper used to touch up fillets if they are causing tightness. (Operation repeated on each main bearing.) Bearing that takes end thrust of crankshaft is tested for end clearance with feeler gage. (End clearance tolerances held to .002 plus or minus). Clearance allowed varies on particular engine from minimum of .003 to maximum of .010. .002 shim previously removed is replaced and crankshaft is bolted down permanently.

One manufacturer makes use of a gun reamer to finish surface on main bearings. (Fig. 6.)

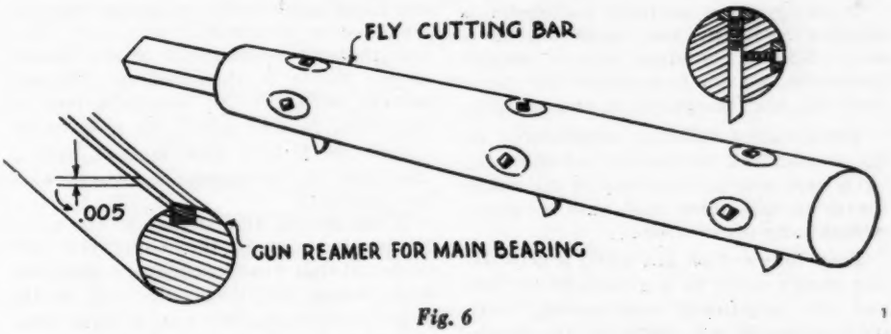


Fig. 6

Procedure on Connecting Rods

After splitting big end of rod, bearing seats are prepared either by milling, boring, or flycutting. (On high priced jobs, the connecting rod and cap are internally ground to provide seats for bearing bushings.)

Lining metal is installed by casting into rod, or by using removable bronze backed bushings.

If bushing halves are eccentric type compensating shims are added to bring inside diameter to approximate circularity.

Rod and cap faces are milled or ground to provide good joint between cap and rod.

With cap bolted to rod, bearings are bored, flycut, or broached to semi-finish size.

Bearings are line reamed to specified size.

Bearings tested on oversize arbor, which gives enough clearance for expansion and oil clearance.

Burnishing operation. (Not to be confused with burning-in as the rod is not clamped around the mandrel tight enough to cause babbitt to flow).

Rods are installed on crankshaft with pistons attached and entire assembly is ready for preliminary block test.

The method outlined presupposes that the crankshaft is of uniform diameter on all bearing journals, in order to secure uninterrupted production.

Methods No. 2 and 3

The second and third methods differ from this procedure only in that the bearings are surface finished by hand scraping. Most of the material is removed by the line reamer and the bore is circular before scraping. The variation in crankshafts, however, accounts for the fact that the final fitting is done by hand, rather than set the line reamer to accommodate each individual crankshaft. The third method, however, is strictly a hand-fitting process.

The fourth and fifth methods should be interesting from a maintenance standpoint. Bearings that are fitted by either of these two processes are very seldom if ever equipped with shims for adjustment. When wear develops from any cause whatsoever, the bushing is replaced to compensate for the wear. The micrometer and test arbors are utilized to check the crank shaft journal diameter and the internal diameter of the bearing. It is claimed by manufacturers that the "no shim" method of fitting bearings gives unusually long bearing life and is instrumental in conveying to the maintenance man the importance of circularity of the crankshaft journals in bearing maintenance operations.

The absence of shims avoids oil leakage past the bearing joint which is a possible occurrence with bearings equipped with shims.

The sixth and last named process of bearing fitting is very popular among the large production firms. The rough bore and line ream operations are utilized to prepare the bearings for the burning-in operation, which is done to impart a glazed surface to the bearing surface. Unlike the burning-in operation as carried on in general maintenance, the caps are allowed not to exceed .002 rock on the shaft to allow stock for flowing the metal.

The Big Ideas of Circularity and Alignment

It is not within the bounds of reason to expect that the factory methods mentioned previously can be transplanted bodily to the maintenance field. The two basic ideas of **alignment** and **circularity**, which are the fundamentals of factory methods, can be always borne in mind, however, and applied to the job in hand regardless of the equipment available.

The second installment of this article will appear in an early issue.

Review of Racing Car Construction

Intimate Views and Descriptions of Three Popular Speed Engines

THAT motor car racing contests are beneficial to the industry from anything but a publicity standpoint is doubted by many and supported by a few. Without entering into a useless discussion let us pick out a few facts that will bear investigation and analysis.

The greatest difficulty experienced by the owner and the builder of the very early cars was the tendency of the mechanism to lay down and quit at times, without any provocation.

Then followed on era when practically any engine could be depended on to start and run practically continuously until its functioning was ended by the breakage of some vital part.

The breakage of vital parts of the engine and chassis was not an uncommon occurrence among American cars previous to 1908. If the advertising copy of the, then, medium and popular priced car is referred to, the investigator will find that in the majority of factory ads particular emphasis was laid on the "Oversize axle designed for a 60-hp. engine," the "Oversize transmission," and the "Sturdily constructed 30-hp. engine." The trend in short was to make the part heavier if it had developed defects, rather than proportion the part according to the duty imposed on it. Thus the breakage of the various parts was solved to some extent by increasing their size.

The famous Pope Toledo, which was considered one of the best American cars in performance, was hopelessly outclassed in competition encountered in Europe in the time of the early Grand Prix races. The German Mercedes and Benz, the Italian Isotta and Fiat, and French Panhard and Darracq, and the British Napier and Rolls had, at that time, been developed to a much greater state of perfection through the lessons learned in racing. The laboratory equipment of today was not then in existence. The results of owners' experiences had not supplied the necessary development data so that the punishment any mechanism could assimilate was determined by its behavior in a race. It is true that the performance of any chassis in the hands of thousands of different owners will give an excellent idea of just what part or unit is in need of revision, but it is a slow method, and at that time the thousands of owners were not available.

If we review the history of the automotive industry in this country it will be found that practically every manufacturer whose activities date back to the years previous to 1909 has, at some time, engaged in racing, for instance some of the well-known cars of today, Buick, Chalmers, Studebaker (then known as the E. M. F.), National, Marmon, Mercer, Apperson, Locomobile, Oldsmobile, Case and Packard.

Invasion by the Foreigners

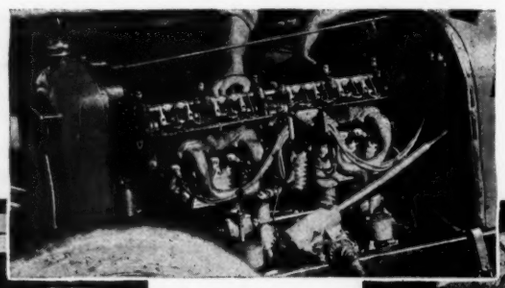
The 300-in., high speed, light weight Puegeot was brought to the U. S. in 1913 and in competition at Indianapolis that year won handily the 500-mile race. It was brought over here after a very successful two years of racing in France. The construction and design incorporated several features that were as yet untried in the United States because American designers had not then developed any high speed 300-in. engines. The crankshaft speed of the Puegeot was slightly over 3000 r.p.m. The scavenging type of hollow crankshaft lubrication was then practically unknown here, and the overhead camshaft without the use of rockers was an innovation. Four valves per cylinder, an aluminum cylinder block, and an aluminum alloy differential housing were other features that were more or less revolutionary to American designing practice of that day. A similar car campaigned during 1915 and 1916 by Resta won the majority of speed contests for that period.

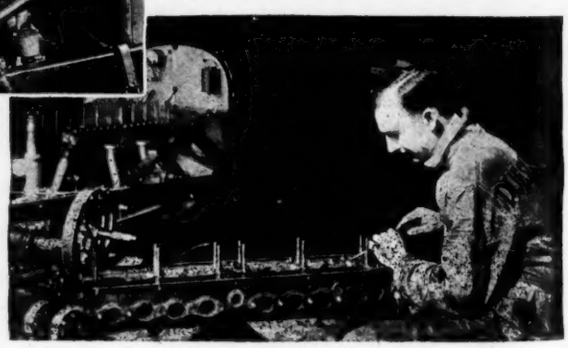
Has Racing Affected the Trend?

It may have been merely coincidental, but nevertheless, since 1913 the trend has been toward higher crankshaft speeds, light weight construction or, more aptly, "proportioned" construction of the entire chassis and hollow crankshaft lubrication. The horsepower to weight ratio has been materially reduced and better performance and greater tire mileage has been secured with equal or perhaps greater reliability. The tendency has been towards engines of less displacement and today the engine of 450-in. displacement is rarely seen. The 300-in. stock car engine of today is doing the work of the 450-in. engine of 1911.

The power produced by any internal combustion engine is directly proportionate to the amount of fuel it can burn in given time. Or rather the amount of heat it can extract from a given amount of fuel in a given time. Figured on a basis of cu. in. displacement per minute, the 183-in. small bore high speed engine has considerably more than half the displacement of the 450-in. medium speed engine. As an illustration, the 183-in., Duesenberg, straight eight, racing engine delivers 114 hp. at 4,250 r.p.m., or, its displacement in cubic inches per minute is 183 × 4,250 or 777,750 cubic inches per minute. The 450-in. engine delivered its maximum at about 2,400 r.p.m., its displacement is then 450 + 2,400 or only 1,080,000 in. per minute.

In 1911 there existed one school of designe the product of which was the slow to medium speed engine with a





Center—Assembled view of Duesenberg engine. Note that rocker shaft is mounted directly above camshaft. An aluminum cover not shown encloses the valve action mechanism. Two Miller carburetors are used. Left—Same chassis with cylinder head removed. One of the drop forged brake drums with machined cooling nibs is visible at the extreme right. Right—The camshaft bearings which are located in the cylinder head did not have perfect contact and they are being touched up with the scraper.

weight to power ratio of approximately 13 to 1. Since 1911, even among the so-called conservatives, this ratio has been reduced to about 9½ pounds to the horsepower. Though not carried as high as the average 300-in. racing engine, the crankshaft revolutions of the Marmon, Cadillac, Pierce-Arrow, Winton, Packard and Peerless, taken on an average, are at least 25 per cent higher than in their 1911 engines. The popular and medium price class shows a comparatively higher average crankshaft speed at maximum power. These are some of the things that must be considered before it can be truthfully and definitely stated that racing has been of no benefit to designing. Finally it should be remembered that racing furnishes a forum for information that can be put into practice, without the necessity of every manufacturer taking an active part in racing competition.

Three American designers have been most active in representing America at the annual 500-mile race at Indianapolis and on other tracks during the season. Whether their efforts and experience gained during this time will profit them remains to be seen, nevertheless at least one of these men has modified his racing chassis slightly and is now offering it as a stock car on the open market. The Packard Co. has recently announced its intention to engage actively in racing this season, for engineering reasons. Mercedes, Sunbeam, Fiat and A. C. have done extensive development work on the 122-in. engine and, no doubt, one or more cars bearing these name plates will be pitted, next year, against the best America can offer.

Duesenberg Straight Eight

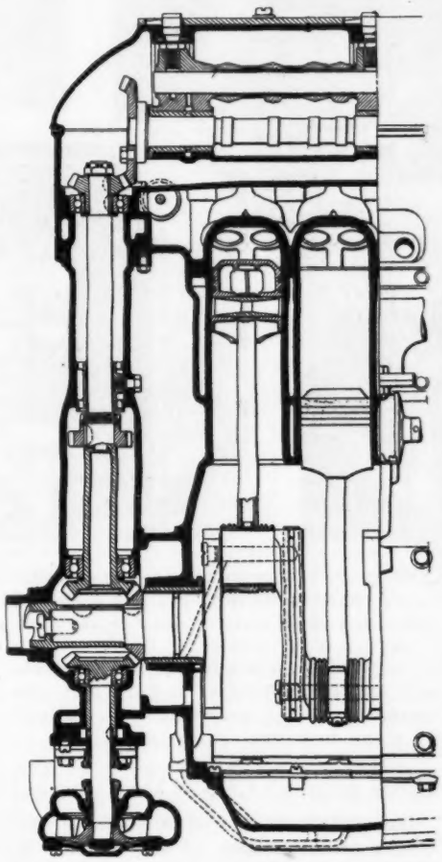
The eight cylinder bores are cast in one block of cast iron. The bore is 2½ in. and the stroke 4⅝ in.

The crankshaft is forged, and heat treated, the material being a steel with a high chrome and nickel content. The shaft is carried on three main bearings, the two front being of the plain type and the rear a ball bearing of the single row, combination, radial, and thrust type. The connecting rod journal pins are 1⅞ in. in diameter and 1⅞ in. long. The main bearing journals are all 2⅜ in. in diameter. The front bearing is 2⅛ in. long, the center bearing 2½ in. long and the rear a single row ball No. 220. The center and front bearings are split and babbitt, cast directly in bronze, and are bolted directly into the crankcase. It is claimed that this construction gives an abnormal capacity for carrying away heat.

The connecting rods are tubular and are made out of chrome nickel, heat treated and have a ½-in. hole drilled through their length. The wall thickness at the upper end is 1/16 in. increasing to 5/64 in. at the lower end. The babbitt is cast directly into the rod and cap and is of .020 in. thickness. The lower end of the rod at the bearing is ribbed for stiffness and for cooling purposes.

Pistons are of aluminum alloy, Magnalite being used on some of the racing engines in the Indianapolis race. The weight of pistons is approximately 6½ oz. Two rings of ⅛ in. thickness are used at present. The rod assemblies, complete with bolt, piston, bearings and piston pins and rings, vary according to the piston material, but will average between 24 and 28 oz.

The front drive gears are made from



Section through front cylinder of Duesenberg straight eight

3½ per cent nickel steel of a very low carbon content. Gears are case hardened and glass hard, while all other parts of the shaft and stem are left soft. All gears in the engine are carried on ball bearings.

The oil pump is located just below the crankshaft at the front and is just above the water pump, which is placed as low as possible in order to get the full benefit of the weight of the water for pump efficiency and low center of gravity. The water pump is driven by an extension of the oil pump drive shaft.

The center gear on the vertical drive shaft drives the generator which is on the right side of the engine and which revolves at three-fourths engine speed.

The camshaft, which is located directly below the rocker shaft, is made of 15-20 open hearth carbon stock and is fitted with a flange in front for bolting on the timing or camshaft gear. This bevel gear is equipped with five holes on the hub, and the gear has 32 teeth. Moving the gear one hole gives a timing adjustment of one-fifth of a tooth or 2¼ degrees.

The surplus and overflow oil from the oil pump is forced to the detachable head and to the front bearing of the camshaft, from which it is fed through the drilled camshaft to all camshaft bearings. The front camshaft bearing also furnishes oil to the rocker arm shaft, providing lubrication for the rocker shaft bearings. The faces of the cams are oiled automatically because the camshaft runs in a trough in the head casting and catches all the surplus oil from the rocker arm bearings.

The distributor is driven from a center gear on the camshaft and is mounted on the right of the removable cylinder head. It is removable by disconnecting the spark control and removing two nuts which retain it on the two studs screwed into the head. The tachometer is driven from the rear end of the camshaft.

The removable cylinder head carries the 24 engine valves. Two exhaust valves of 1⅛-in. diameter are used per cylinder and one inlet valve of 1⅛ in. diameter. The inlets are on the left side of the engine and the exhausts on the right side. Both inlet and exhaust valves are made of tungsten steel with the ends of the stems left just as soft as possible. Bronze valve guides are used to carry off the greatest possible amount of heat. The valve springs are of chrome vanadium.

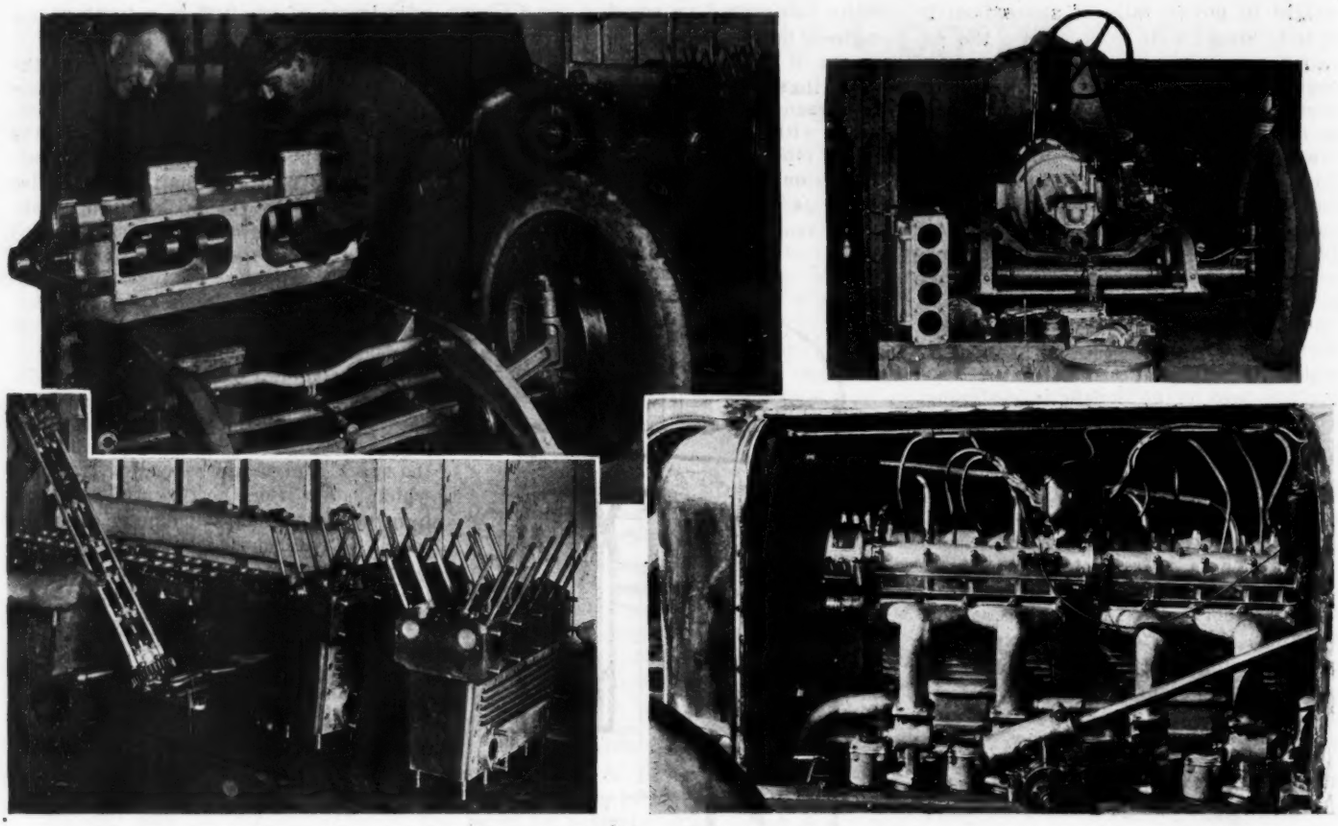
Only one spark plug is used and this is located on the inlet side. The best results to date have been obtained using two 1½-in. carburetors with the inlet manifolds having an inside clearance of 1 9/16 in.

All plain bearings throughout the job are made of Non Gran bronze, whether babbitt lined or plain. Two large hand hole plates are fitted on the side of the engine so that pistons may be removed from the side or bottom as may be most convenient.

The engine was laid out with the thought of getting 92 hp. at 3,800 r.p.m. Most of these engines have their maximum torque at 3,700. With careful setting and all conditions favorable these engines have developed 114 hp. at 4,250 r.p.m. on the dynamometer. In this case the valve lift was .380 on the exhaust and .440 on the inlet, using 1¾-in. carburetors. A few of the cars were equipped with a Brown Lipe transmission and a Brown Lipe multiple disc clutch. The cars seem to have a slightly better balance when the Duesenberg single plate clutch is used. The compression ratio is 5.6 to 1, that is, the compression space in the head is equal in volume to 1 in. of piston travel.

The power plant complete less transmission weighs 535 lbs.

The Duesenberg jobs gave an excellent account of themselves at the Indianapolis race. There were nine Duesenberg chassis entered and only one failed to finish. The single failure was Jules Ellingboe who skidded on one of the turns and after spinning around three times came to rest with a broken axle shaft. The



Upper left—Miller engine, Durant chassis. The four armed bronze engine support is fastened to the case at front. Lower left—the ten bearing camshaft in the foreground. Note that shaft is driven by spur gear. Upper right—Jimmy Murphy's chassis. Cylinder blocks have been removed to regrind valves. Lower right—Assembled view of same engine after winning 1922 race

eight remaining Duesenbergs all finished in the money and in the following order: Hartz, second; DePalma, fourth; Haibe, fifth; Wonderlich, sixth; Fetterman, seventh; Vail, eighth; Thomas, tenth.

The chassis construction of each of the Duesenbergs was similar, except that Wonderlich's car used the four-wheel brake system during the race. The eight other chassis were equipped with these brakes but the other drivers did not consider them necessary and they were disconnected.

The rear axle housings on these cars were built to the specifications of the Duesenberg Co. by the Columbia Axle Co. The front axle is a special Duesenberg design of tubular construction to accommodate the Duesenberg system of hydraulic braking. The tubular member acts as the fluid supply line to the brake actuating pistons on each axle spindle. The rear axle shafts are made of molybdenum steel. A 15-52 rear axle ratio was used on practically every one of the cars. This ratio allowed the engine to turn up a maximum of approximately 4,000 r.p.m. on the Indianapolis track. The wheelbase of the cars is 106 in. and 32x4-in. tires were used in front while the rear tires in most cases were 32x4½ in. The layout is extremely accessible and it claimed that the engine can be completely dismantled in two hours.

The cars raced at Indianapolis were only slightly different in detail from the stock car now marketed by this company. The engine changes consisted only in higher compression, the use of eight-volt ignition, lighter pistons and the mounting of all gears on ball, instead of plain, bearings.

Miller Engined Chassis

Harry Miller of Los Angeles is the designer and builder of the engines in the Murphy Special, the Leach Special of Elliots, the Leach Special of Miltons, and the Durant Special driven by Cliff Durant.

The eight cylinders are cast in two blocks of four. Bore 2 11/16 in., stroke 4 in. Lightness and a clean appearance has been secured by machining the cylinder blocks all over on the outside. The cylinders are of the solid head type with the exception of the one in Elliot's car, which has a detachable cylinder head. Detachable aluminum side plates act as the water jackets for the cylinders. These plates are retained by countersunk head screws and are ribbed for purposes of heat radiation. The inlet and exhaust passages are of rectangular section with rounded corners, one inlet and one exhaust port for each cylinder being brought outside for attachment of the manifolds. The effort of the designer to get a clean layout is depicted in the method of retaining the cylinder blocks to the crankcase. The holding-down studs of the blocks register with corresponding holes in the top face of the crankcase and the nuts are put on from below, and inside the crankcase.

The crankcase is designed for three point support, the rigid anchorage being at the rear. The front support is a spigoted fitting of bronze having four arms. The fitting is detachable from the crankcase and because of its high conductivity is an aid in conducting the heat from the case to the chassis frame.

The three bearing crankshaft is very similar to the Duesenberg crankshaft and is of massive proportions especially at the crankpin webs. The front bearings are 2⅜ in. in diameter of the plain, bronze backed, babbitt faced type. The rear bearing relieves the plain bearings of all end thrust and is of the single row annular ball type. The shaft is drilled throughout its length for dry sump scavenging lubrication. The curved crank cheeks of large proportions are visible in the view of the crankcase assembly shown above. Considerable trouble was experienced with the eight-cylinder shaft initially as it was found that continued running at high speed developed well defined cracks on the surface of the steel. Actual breakage of the shaft did not occur, but it was apparent that something akin to fatigue of the metal was taking place. This trouble was overcome by the use of a heat treated shaft of heavier section at the crank pin cheeks.

The design of the connecting rods is similar to the Duesenberg, both being of the tubular type with a very thin wall section. The lower ends are ribbed on rod and cap for heat radiation and strength. The pistons are of aluminum

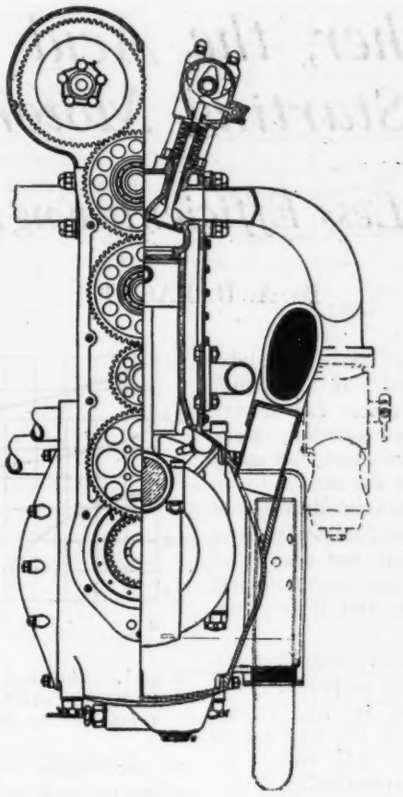
alloy of Miller design and manufacture and carry rings ⅛ in. wide.

The valve system on this engine is worthy of mention and is interesting from a constructional standpoint. Two camshafts, receiving their drive through a train of ball bearing mounted gears, are used for actuating the 32 valves of the engine. The valve action proper is of the modified Hispano Suiza type, eliminating the use of rocker arms. The actuating mechanism of each shaft is mounted in two aluminum housings. The lower housing, which is retained with the upper housing by means of long cylinder studs, serves as a guide for the eight thin walled cups which transfer the movement of the cams to the valve stems. These thin walled cups are fitted with a small nib or dowel which is an integral part of the cup to prevent their rotation in the lower housing, and are acted on directly by the camshaft.

Each camshaft and housing assembly is split vertically, midway between the cylinder blocks, as shown in cut. The halves of the camshaft are joined by flanges and bolts at the point where the housings are split. It is claimed that this two-piece construction prevents any distortion due to movement or lack of alignment between the two blocks. Easier machining and accessibility are also gained by this construction.

The spur gear on the end of each camshaft is fastened to the camshaft flange by four bolts which permit of very close timing adjustment. Ten plain bearings in each upper housing assembly support the camshaft and permit of a shaft of comparatively small diameter.

The sixteen thin cups in each housing, previously referred to, bear directly on the stems of the sixteen inlet and exhaust valves, on each side of the engine. The diameter of inlet and exhaust valves is 1 3/16 in. The angle mounting of these valves allows for ample water jacketing of the valves and spark plugs. The spark plugs, one to a cylinder, are mounted almost directly over the top and center of the combustion chamber. A hole is bored through the inner and outer jackets and a thin walled steel bushing is screwed into the opening thus made. The spark plug is screwed into this opening and is entirely surrounded by water.



Section through four cylinder Frontenac engine. Large breathers are designed to assist in cooling crankcase interior

Lubrication is secured by forcing oil through the drilled crankshaft from whence it is conducted up to the camshaft housing, lubricating the valve-actuating mechanism. Surplus and overflow oil returns to the pump located at the bottom of the engine. The return path of the surplus oil is over the train of camshaft driving gears.

The ignition generator is located just in front of the front gear housing and is driven from a gear on the crankshaft. The Delco ignition distributer is driven from the left hand camshaft, the spark advance movement being secured by use of a Bowden wire control.

The intake passages are cored to take a 1½-in. carburetor of Miller design and manufacture. On account of each cylinder having its own individual inlet port, the use of multiple carburetors is an easy installation. The engines used by Durant, Elliot and Murphy were fitted with four inlet manifolds feeding two cylinders each and using four single carburetors. Milton's engine utilized eight separate inlet manifolds connected to four Miller duplex type carburetors having one float mechanism for two separate mixing chambers. The carburetor throttle valves are interconnected and synchronization of the throttle valve opening is secured through adjustment of clamps on the serrated throttle shafts.

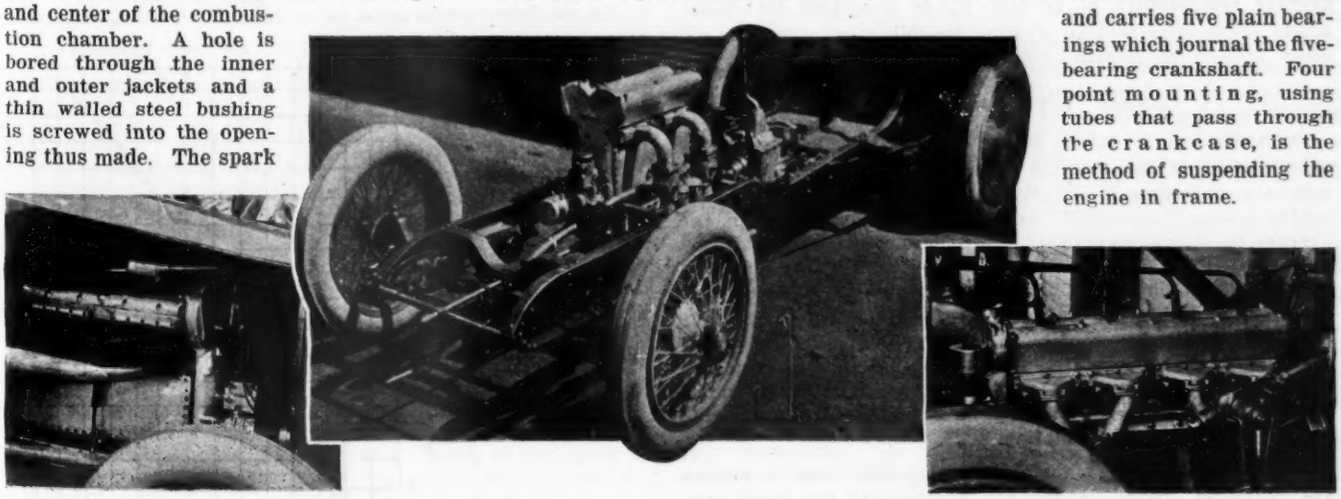
The engine develops well over 4,000 r.p.m. before showing a drop in power.

The Miller engine in the Murphy Special won the 1922 International Sweepstakes race at Indianapolis and established a world's record for the distance. The Miller engine in the Leach Special driven by Milton gave no trouble during the race but was forced to quit because of a broken gas tank mounting. Although the Miller engined Leach Special driven by Elliot and the Durant Special did not finish in the money, they were running at the finish of the race.

The Frontenacs

The four-cylinder models of the Frontenac, which have been previously described in these columns, are notable because of the great amount of aluminum used in their construction.

The eight-cylinder engine incorporates a block casting of cast iron. The bore is 2⅝ in. and the stroke 4 7/32 in. The valve actuating mechanism is similar to the four-cylinder models which incorporate a light finger interposed between cam and valve stem. There are four valves per cylinder and two camshafts are used. The crankcase is of aluminum and carries five plain bearings which journal the five-bearing crankshaft. Four point mounting, using tubes that pass through the crankcase, is the method of suspending the engine in frame.



Left—Open valve model Frontenac four in Leon Duray's chassis. Center—Latest model enclosed valve four cylinder engine as used by Mulford at Indianapolis. Note double drop on chassis frame to give lower center of gravity. Right—Frontenac eight in Baker's car. This engine has five main bearings as contrasted with three in the Miller and Duesenberg jobs.

Cold Weather, the Acid Test of the Starting Motor

Battery and Starter Less Efficient; Engine Harder to Crank

By A. H. PACKER

MOST men engaged in the business of battery maintenance will insist that business is better in the winter than summer despite the fact that motor car driving is considerably diminished during the colder months. Every motorist knows that his electrical troubles are multiplied many times in cold weather and the only recourse for him is to go to a shop for repairs or adjustments. But practically all cold weather "grief" is expressed by the stranded motorist who says, "my battery quickly runs down and will not crank the engine." Let us for a moment look into this condition and determine in some small measure the causes and, if possible, the remedies.

Fig. 1 shows three curves of an 80 ampere-hour battery discharging at its normal five-hour rate of 16 amperes. This means that at the standard temperature of 80 deg. F. the battery will deliver 16 amperes continuously for five hours down to the minimum allowable voltage of 1.75 volts. In the figure, cell voltage is plotted in the perpendicular direction while time in hours is plotted in the horizontal direction. In all curves the discharge rate of 16 amperes was held constant throughout.

It will be noted that when the battery was discharging at a temperature of 80 deg. F. it stood up for exactly five hours down to a final cell voltage of 1.75. This amply fulfils all ordinary requirements for summer work, but see what happens when the temperature is lowered. In the discharge at precisely the same ampere rate at 20 deg. F. the cell voltage falls off so rapidly that it reaches the minimum in about three hours. In other words, at 80 degrees the battery gives its full rated capacity of 80 ampere-hours, at 20 degrees the capacity has fallen to 48 ampere-hours, a drop of 40 per cent, and at 20 degrees below zero the available capacity is only 20 ampere-hours, a drop of 75 per cent from rated capacity. Fig. 2 is a curve showing this relationship graphically for all temperatures up to 100 deg. F. Since most of the driving during the three winter months must be done despite an average temperature of 20 deg. F., or less, this fact alone would cause considerable starting trouble even supposing all other factors to remain constant.

Another "Fly In the Ointment"

But there is a second fly in the ointment because of certain peculiarities of the starting motor. Fig. 3 shows a curve with the percentages of efficiency plotted against r.p.m. of engine speed. This curve is characteristic and represents the average of several machines. It will be noted that the highest efficiency is obtained with engine speeds between 100 and 110 r.p.m., which means that the consumption of power in the starting motor per unit of power delivered to the engine in cranking is least at these speeds. The cause of this maximum efficiency at a relatively high speed is readily explained by the fact that the counter E.M.F. produced in the motor armature is increased as the speed is increased, thus cutting down the current consumption.

Now there are many variable factors that tend to govern the cranking speeds of the gas engine, but the most conspicuous of them are terminal voltage of the battery, viscosity of the lubricant and friction. Tests on the various lubricating oils reveal the fact that some of those highly recommend-

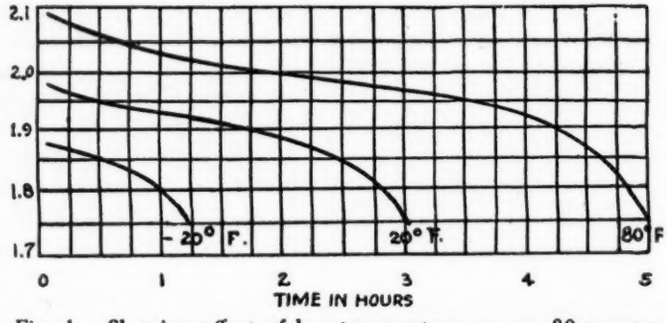


Fig. 1. Showing effect of low temperatures on an 80 ampere-hour battery discharging at the 5 hour rate (16 amperes) at the temperatures 80, 20 and 20 below zero degs. Fahrenheit.

ed for engine lubrication become a viscous, jelly-like mass when reduced to temperatures of 10 to 20 deg. F. Since the crankshaft or other moving parts must either move through the oil or force the oil to flow, this makes the engine much more difficult to crank in cold weather. The subject of friction as affected by low temperatures can not be summed up so easily but may be better understood by taking an example. In a certain type of gas engine the bearing caps are made of aluminum. Now it is a familiar fact that metals expand when heated and contract again when their temperature falls, but the amount of expansion and contraction is different for every metal. Therefore, if aluminum bearing caps are adjusted to clamp the crankshaft snug at ordinary running temperatures, there is a possibility that, owing to the different expansions of the two metals, it will bind at low temperatures. This is exactly what happens because the aluminum contracts much faster than the steel and the torque of the engine is enormously increased.

All this increased load on the starting motor means one of two things. Either the cranking speed is going to be reduced or the available power must be increased. Since the available

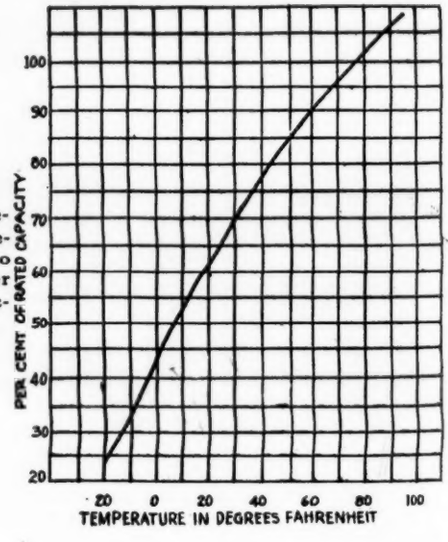


Fig. 2. Showing relation of ampere-hour capacity to temperature (In per cent of rated capacity.)

power from the storage battery is a more or less fixed quantity in any given case, the only other possible thing happens—the cranking speed is reduced. As has already been pointed out, the capacity of the battery is also greatly curtailed by the low temperature. The result is that the reduced power of the battery is used up cranking the engine at a speed so low that the fuel will not ignite, because carburization is very poor in cold weather. The curves of Fig. 4 compare the power in kilowatts required to crank a representative engine of 200 cu. in. displacement at the temperatures of 80 and 20 deg. F. To obtain a speed of 50 r.p.m. at 20 deg. F. requires 1.9 k.w., an increase of 171 per cent.

Anticipation of Weather Conditions a Factor In Designing Starting Motor

From the above data it will be clear that to get good performance from the starting system in cold weather it will have been necessary to anticipate winter conditions in the design of the starting motor and the selection of the size of storage battery. A great deal of attention has recently been given the selection of the correct size of battery for performance at normal temperatures, but if the system is to operate well under all conditions it must be designed to meet the worst. A battery is only 60 per cent efficient at 20 deg. F. Therefore, if 60 per cent of its rated capacity is not sufficient to meet every day requirements, the battery is too small and a larger one should be used. This is practically the only recourse for any system already in use, but where a larger battery is installed it must be borne in mind that the generator output has been adjusted only to keep the smaller size in good condition. It is not possible to change a starting motor to cause its highest efficiency to come where it will meet the worst operating conditions, i. e., at low speeds, but it might well have been designed originally with this idea in mind. A change in the gear reduction between the starting motor and the gas engine such that the engine speed would be decreased and that of the starting motor increased for a given load would probably be a step in the right direction. Perhaps the same result would be obtained in the design of the motor itself by increasing the field strength or increasing the number of turn in the armature so that the counter E.M.F. would build up quickly at low speeds. Of course the objection to any of these changes would be that the motor would have to operate at excessively high speeds or with a lower efficiency in normal summer temperatures. But that would be compensated for by the fact that the battery would then be at its best. The point is that one of the two should be changed to meet severe winter driving conditions and as yet it has not been found possible to evade low battery capacity in cold weather.

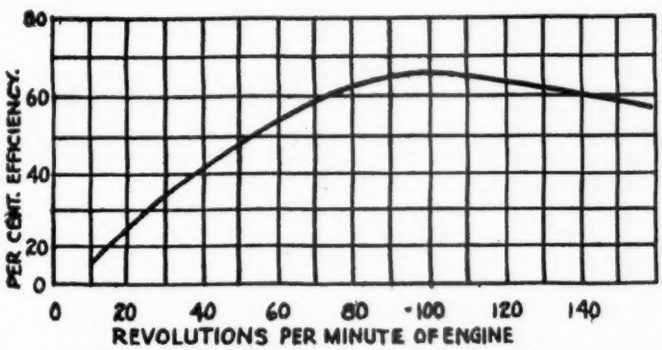


Fig. 3. Average efficiency of starting motors

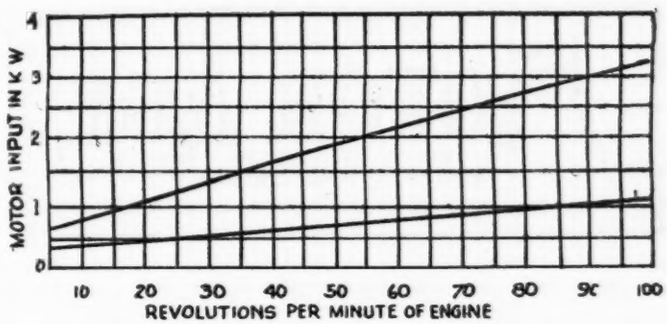


Fig. 4. Approximate power required to crank engine of 200 cu. in. displacement. Upper curve at 20 deg. F. Lower at 80 deg. F.

23 Years Ago This Week In Motor Age

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About the Benz Vehicles

The German motor vehicle industry is dominated by two firms, the Daimler Motor Co., of Caunstatt, and Benz & Co., of Mannheim, both pioneers in motor construction and parent concerns for large vehicle manufacturing establishments in France and England, in which the mechanical foundation consists in the Daimler and Benz patents, which date back to 1885 and 1886. The first Daimler patent was obtained Aug. 29, 1885, and referred to a gasoline motor applied to a velocipede. During the same year Carl Benz had built the first modern gasoline motor vehicle, which had three wheels and room for three persons. The motor was of about 1½ to 2 hp. and the patent for the construction used in this vehicle was dated Jan. 29, 1886.

Minor Mention

The National Carriage Builders' Association in convention in Indianapolis voted to exclude manufacturers of automobiles or automobile parts from membership.

The machinery was set in motion this week at the factory of the Mobile company now in course of erection at Tarrytown, N. Y.

Jacob Rech & Sons and Fulton & Walker, prominent wagon and carriage builders of Philadelphia, are constructing automobiles of the gasoline and steam-driven varieties.

Pneumatic tires advertised and illustrated in MOTOR AGE were of the single tube type and were fastened to the rim by screws sunk into a metal plate embedded in the fabric.

Chicago's Dead Ordinance

The city authorities of Chicago are now enforcing an ordinance passed July 6, providing for examination and licensing of motor vehicle drivers. The measure provided for a board of examiners to consist of the city electrician, the city engineer and the health commissioner. Vehicles are required to be fitted with alarm bells, and are not allowed to run over eight miles an hour. A brake has to be fitted which will stop the car within 10 feet. The reason assigned for the non-enforcement is that Mayor Harrison doubts the wisdom of the measure—or perhaps the competency of the examining board; for who shall examine the examiners?

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The Winter Service Issue

AGAIN we hand you a Winter Service Issue and as we do it our hopes are high that you may find this copy of MOTOR AGE helpful and profitable to you. We have sought to make this issue a practical document. We have tried to put into it the things that we believe to be the greatest needs of the automotive maintenance industry. To determine what should be printed, the members of the staff visited many maintenance establishments of various sizes and they found varied degrees of efficiency.

After this long study of conditions as they are, we held a consultation as to what should be included in this issue to both help and interest the great dealer and maintenance field. We hope that we have not misread the indications or the tendencies. We believe that the dealers of this country are convinced that winter business exists and that they are going to do their best to get a liberal share of it. In this we have tried to be helpful.

We also believe that many dealers, especially those who have come into the industry through the shop, are not especially keen salesmen. This is their misfortune but it is something that can be remedied to a very large extent. We have included in this issue some things that we believe will be helpful in making these men better salesmen.

We believe that most dealers prefer to maintain a steady force of workers the year round in their shop. This is, of course, good business. The difficulty has been that there was not much work and it was expensive for the employer to carry these men over the dull period and, despite his desire to keep them, he was forced to let many of them go. We have sought to show this employer how he may keep these men profitably—by getting more business and by making their winter work a source of greater profits next summer.

Something different is presented this year in the "Illustrated Winter Service Issue," which is almost a complete publication in itself. We believe that this presentation will be helpful as well as pleasing and you will find by reading the type text on other pages that the writers have frequently referred to the illustrated pages to make clear their points.

Above all, we believe that the automotive maintenance industry is enjoying a healthy growth and it is soon to enjoy a greater esteem of the motor vehicle driving public, and we have tried to reflect this idea throughout our pages.

"The creditors are a superstitious sect, great observers of set days and times."

The Future of Maintenance

IN this issue of MOTOR AGE is printed an article that deals with the probable future of the automotive maintenance industry. Many things must happen to bring about the desirable future that we foresee. Two very important opportunities for the advancement of this industry are offered this month and we hope that those who are interested in the future of the industry will not be neglectful under the circumstances.

The first of these dual opportunities is the meeting of the factory service managers in Chicago Nov. 14 and 15. This body functions under the direction of the Service Committee of the National Automobile Chamber of Commerce. Its history of semi-annual meetings is quite creditable and much good is before it. At the meeting to be held in Chicago, one day will be devoted to the question of local maintenance or service managers associations. We believe that there is an opportunity for great good in this movement and all who are interested in such organizations should attend the meeting. There will be present delegates from some of the existing local maintenance managers' associations and these delegates will talk over their local problems with the factory representatives in the effort to arrive at a common understanding.

The second opportunity is the Regional Conference on Vocational Education at Detroit the week of Nov. 27. A special session has been called at the Tuller Hotel on the morning of Nov. 29, during this conference, for the "discussion of standards for courses of instruction in automotive mechanics." Some of the leading vocational educators will attend this meeting, which is open to persons interested in the practical side of automotive maintenance as well as the educators. It is the hope of the Federal Board of Vocational Education, sponsors for the meeting, that many practical men will attend.

At present such education is under a distinct cloud because of the number of applicants for jobs in maintenance shops who set forth the claim of a school education when, in fact, they have been victims of "educational boosters" and, instead of really getting an education that

should be the foundation of a high class mechanic's career, they have only been given some superficial instruction that explains merely what to do and not why to do it. The maintenance manager of today is appreciative of the advantages of thorough education in this work and it will be a great satisfaction to him to know what schools are properly preparing his apprentices for him. Today, this maintenance manager is skeptical of all "education" because he has seen too many "educated" mechanics fail. He knows full well that education is necessary but he has no way of telling the good from the bad except by a tedious examination or putting the applicant to work.

Here are two opportunities for the advancement of the automotive maintenance industry that should not be neglected. Manufacturers, engineers, dealers and independent maintenance men are interested.

"Necessity never made a good bargain."

Politics

AMONG the other profitable winter tasks of the automotive dealer is that of asserting himself into the political situation and getting from it a fair deal for the industry that he represents in his community. The home appeal is always the strongest appeal to the legislator, because the satisfaction of the neighbor means votes.

Recently the Illinois Automotive Trade Association sent out a statewide request for the dealer members of that association to get into touch with the candidates for legislative offices and ascertain their attitude toward the automotive industry and the questions that were likely to come before the legislatures of the state and nation. This was with the objective of approaching these men before the election on these questions, rather than afterward. It is well known that the candidate is more open to argument before the votes are counted than after.

It is, of course, too late to undertake anything of that kind now, for next week the voting will be over. However, there is time for the dealer to make the acquaintance of the legislator, to talk intelligently with this legislator elect, to educate him on the utility of automotive transportation and especially to show to him that it is quite unfair that the automotive vehicle be considered chiefly as a means of raising taxes.

Most of the legislative attacks on the automotive vehicle have been due to a misunderstanding of these vehicles and the owners. Most legislators are honest and when shown who own automotive vehicles and why, they will be much more reasonable in their attitude.

"Diligence is the mother of good luck."

Where Are You?

THE location of any business is usually a large factor in bringing trade to the doors. Whether the customers ever come back is a question that is usually affected by the treatment they receive, but the first appearance is caused nine times out of ten by the fact that they happened to be going by.

Some concerns make their location the chief stock in trade, which brings to mind a certain retail shirt concern in New York City which had a wonderful location where crowds were constantly surging past their show windows. They made a specialty of a dollar shirt, and evidently were satisfied to sell a customer once, if never again, and depend on a new stock of suckers to keep things moving. I bit once so I know. The shirt was scant in one essential dimension so that adequate anchorage could not be secured, and its color faded away with remarkable efficiency.

Other concerns, operating on a more stable basis, depend on the reputation they secure by satisfactory service, to bring them a continuous stream of business. Many automobile concerns have maintenance stations in comparatively inaccessible locations, yet such is their reputation that they get plenty of business in spite of this disadvantage.

The average shop, however, will be found to operate to best advantage if both methods of obtaining trade are used, for the prominent location brings in the man who does not feel like making the effort to go out of his way, even when he knows it may be to his advantage to do so. At the same time, satisfactory service is necessary, in order that he will point you out as a place worth going to, rather than a place where one may get stung.

"He that can have patience, can have what he will."

It Is Ninety Per Cent Man, Always

THE success or failure of any automobile business establishment depends 90 per cent on the man at the head.

It is not size of building, potential business, make or makes of cars sold and serviced, size of town and the usual factors we associate with successful business ventures that determine whether a man is or is not going to make money in the automobile business.

In most of its investigation work throughout the country MOTOR AGE generally has found that where a dealer, particularly in the small town, was doing a good business, he was first of all a good business man and a keen student of business psychology. We have been in towns where you could find a dealer handling what might be termed a second-rate car, but who was making money and keeping his hosts of customers satisfied. Then, across the street, we would find another dealer who handled a car that ordinarily sold itself, and yet who said, "Business is rotten."

Because a man is in the automobile business now is no indication that he best fits into that business. The psychology of selling is the same in the automobile business as it is in any other business, and unless the man at the head knows how to sell his business to the community in which he is located, he probably will not get very far. It is the man always, to whom we must look to get the final answer to the question as to whether or not his business outlook for the future is bright or gloomy.

And so, the winter problem ahead of the small town dealer, especially, will rest largely with the dealer himself. He alone must make the final analysis of his situation and take advantage of all the possible avenues of profit.

Red Cross Roll Call

BETWEEN Armistice Day, Nov. 11, and the Thanksgiving Day is the period during which the American Red Cross makes its annual membership campaign, soliciting new and renewing old memberships. This body of American relief workers deserves the support of everyone in order that it may continue to carry out the duties placed upon it by Congress.

Enclosed Car Sales Keep Production Up

Output of Popular Type Limited Only by Body Supply

Truck Demand Shows Steady Advance as Industrial Situation Improves

NEW YORK, Oct. 30.—Production continues to be maintained at a high rate in the face of obstacles occasioned by the railroad situation. It is increasingly difficult to get through shipments of materials, despite various means adopted to expedite deliveries. The diversion to other uses of such rail equipment as would be available for automotive manufacturing centers has necessitated a wider use of motor truck augmented by the employment of boats for shipments from more distant points.

The popularity of the enclosed car is a dominant factor in the maintenance of high production programs. Some factories are reporting a shortage of bodies for cars of this type, due to the unexpected demand at a season, when in other years there has come a perceptible falling off. Where there has been a curtailment of manufacturing schedules it has been due to the inability to obtain a sufficient body supply rather than to any pronounced decline in sales.

With the freight car shortage situation becoming more serious, the industry is experiencing as great a difficulty in shipping its products as in getting its material. Although driveaways are increasing in number they are unable to take care of all the orders in dealers' hands. Manufacturers located at such points as Detroit and Cleveland are making use of boat shipments to a greater extent, to get their products into dealer territories. The northwest in particular, where there is strong evidence of renewed buying interest, is being fed in this manner but even there deliveries are behind.

The export field is experiencing somewhat the same excellent conditions as regards sales, as are apparent in the domestic market. It is very likely that the present year will prove the second best in point of shipments in the history of the industry, exceeded only by 1920.

Parts makers report collections better than a year ago with business for September showing an increase of 62.1 per cent over the same month last year but with car manufacturers purchasing more conservatively than during the earlier months of the season.

It is probable that tire manufacturers will begin shortly to build up reserve stocks to take care of the spring demand. Finished inventories now are low and will require considerable working up before next year to prevent a shortage.

Trucks are showing a steady advance, with sales for the popular makes in industrial sections of the country running as high as 100 per cent over 1921.

ASSOCIATED MOTORS OPEN OFFICES

DAYTON, O., Oct. 28—Executive offices of the Associated Motor Industries have been opened here in a three-story building which has been completely remodeled for the purpose. The building is about 250 by 150 ft. The sales department with spacious display rooms is on the first floor. Officers of the company occupy offices on the second floor. Departmental offices are on the third floor. Will I. Ohmer, chairman of the board of directors, and Louis Ruthenberg, president of the corporation, have offices in the building. Heretofore the affairs of the corporation, which is a merger of the National, Kentucky Wagon, Traffic Truck, Jackson and a number of other companies, have been conducted from a Chicago office.

STEINMETZ MAKES NEW ELECTRIC

SYRACUSE, N. Y., Oct. 24—Announcement is made by the Thorne Machine Tool Co. of this city of the completion of a new model electric car for the Steinmetz Motor Car Co. of Baltimore. This is the first of four which are to be made for experiments which will last about a year before production is attempted. The car has been built under the direction of Charles P. Steinmetz and the work here has been in charge of Oscar C. Kavie and L. W. Moulton of the Manufacturers Consulting Engineers.

In producing the model the aim has been to develop an electric driven vehicle weighing under 2,000 lbs. with a speed up to 40 m.p.h. and an operating radius of 200 miles.

AMERICAN STEAMER GETS FACTORY

ELGIN, Ill., Oct. 28—A reception attended by about 500 persons was given by citizens of Elgin last night to officials of the American Steam Truck Co., manufacturer of the American Steamer passenger car, in celebration of the location of the company's factory here. The American company has taken over the plant of the defunct Duty Truck Company and is now installing machinery for the manufacture of cars.

CONTINENTAL STOCK INCREASED

RICHMOND, Va., Oct. 27—Stockholders of the Continental Motors Co., at a special meeting here, approved an authorized increase in the capital stock to 3,000,000 shares of no par value of which 1,500,000 shares are to be exchanged for the present stock of $10 par value.

APPROVE ROAD BOND ISSUE

KNOXVILLE, Tenn., Oct. 30—The bankers, business men and heads of industries of Knoxville recently met at the business men's auditorium and gave their endorsement to the proposed $75,000,000 bond issue for good roads which will be asked of the legislature next January.

Posters Showing Tire Abuses Sent Out to 125,000 Dealers

Manufacturers' Division of Rubber Association Explains Standard Warranty

NEW YORK, Nov. 1—As its first move in a national campaign to establish permanently the Standard Tire Warranty, the Manufacturers' Division of The Rubber Assn. of America is distributing hangers, showing how tires are abused, to the 125,000 tire merchants representing 120 tire manufacturers.

These hangers, which the tire merchants are asked to display prominently in their stores, point out some of the abuses of tires that may be wilful or entirely accidental, and carry the warning that responsibility for each misuse is not assumed by the manufacturer under the terms of the Standard Tire Warranty. They also point out that tires, like the engine or other parts of the car, require a reasonable amount of attention and ask car owners to avoid the more common abuses in order to get the best results from tire equipment.

"Educate Tire Users"

In its message to tire dealers accompanying the hanger the association says: "It is believed that the poster presents a few important facts and suggestions, with helpful illustrations concerning the more common causes of tire trouble which may properly be termed abuses. These facts and photographs, being offered by the tire manufacturing industry as a whole and not handicapped by being identified with the product of any one company, should give the dealer a means of defending his interest when an unjust claim is being pressed by a tire user. The placard is also a medium through which the dealer can educate the car owner to better care of his tires.

"If the tire seller directs attention to the message of the placard at the time of a sale, it undoubtedly will prevent some of the controversies which later grow out of unreasonable claims for adjustment of tires which have been wilfully or ignorantly abused. That prevention will result for two reasons, at least; one, because directing attention to the poster will have the effect of causing some car owners to care better for their tires, and the other, because it will have served to emphasize to the careless user the announcement in the Standard Warranty that no unmerited consideration will be shown when tires have been abused."

The placard will be followed shortly by distribution to car owners of a pamphlet on the same subject, but in considerably more detail, which will permit of attention to many other forms of tire abuse not covered in the placard.

$742,000,000 for Good Roads This Year

Country Needs More Highways, President Tells Conference

WASHINGTON, Oct. 26—Development of the great network of public highways is one of the prime economic programs confronting the nation, President Harding today told the 300 delegates to the second national conference on education for highway engineering and highway transport, held under the auspices of the Highway Education Board, for a three-day conference.

In a letter from the President, greeting the delegates, he declared that the automobile users of the nation must realize that good roads cannot be had without very great expense, and that some solution must be found for the financial aspect of this problem.

DORT FOUR AGAIN REDUCED

FLINT, Mich., Oct. 28—Along with the introduction of a six-cylinder car, the Dort Motor Car Co. announces a further reduction in the prices of all its 4-cylinder models. The new prices follow:

	Old Price	New Price
Phaeton	$885	$865
Roadster	885	865
Yale sedan	1095	1070
Yale coupe	1045	1020
Harvard sedan	1385	1370
Harvard coupe	1265	1240

The hood and radiator designs have been changed, giving more graceful lines. The company announces definitely that the 4-cylinder car is to be continued.

CASE PRICES REDUCED

RACINE, Wis., Oct. 28—Price reductions on the full line of Model W Case cars and on the enclosed cars of the Model X line are announced as follows:

Model W—	Old Price	New Price
Phaeton	$2250	$1990
Sedan	3250	2975
Coupe	2850	2480
Sport	2200	1950
Model X		
Phaeton	1790	1790
Sedan	2690	2575
Coupe	2550	2480
Roadster	1750	1750

CANADIAN FORD AGAIN REDUCED

DETROIT, Oct. 28—Ford Motor Co., of Canada, Ltd., followed the price cut of the United States company with a reduction ranging from $50 to $85. The phaeton is $445, roadster $405, coupe $695 and sedan $785. There is a price differential of $85 for self-starter and demountable rim equipment. The truck is $495 and chassis $345. The new prices are the lowest the Canadian car ever has sold for.

TWIN CITY TRUCKS REDUCED

MINNEAPOLIS, Oct. 27—The Minneapolis Steel & Machinery Co. announces the following reductions in the price of Twin City motor trucks:

	Old Price	New Price
2 ton model	$2750	$2400
3½ ton model	3950	3500

RICHMOND DEALERS ELECT

RICHMOND, Va., Oct. 28—James H. Kline, automobile manufacturer of Richmond, was re-elected president of the Richmond Automotive Association at its annual meeting at Aqua Vista. A. R. Lane was elected vice-president; H. M. Figgatt, secretary; E. F. Taylor, treasurer. Directors elected were J. H. White, E. F. Taylor, A. F. Franklin, T. G. Sydnor and Kenneth Chaddick. Plans for the 1923 automobile show were discussed and the committee of last year given power to arrange the affair directly following the New York show.

FRANKLIN GETS MORE DEALERS

SYRACUSE, N. Y., Oct. 28—The number of Franklin dealers has increased 27 per cent during the past year, according to Sales Manager S. E. Ackerman of the Franklin Automobile Co. Fifteen per cent of this increase dates from the first of this year. The Franklin company plans to have at least 2,000 points of representation in this country, eventually.

BROOKLYN ENCLOSED CAR SHOW

BROOKLYN, Oct. 27—Brooklyn's autumn show, held individually in the salesrooms of dealers as a sequel to enclosed car week of the past two years, closed tonight with a good record of business done and prospects obtained. The Brooklyn Motor Vehicle Dealers' Association, under the direction of Ralph Ebbert, executive secretary, conducted a vigorous promotion campaign for the show, with the result that dealers in virtually all lines report attendance in their salesrooms considerably ahead of the past two years. Actual sales were held down somewhat by inability of dealers, in a good many cases, to promise prompt deliveries.

Salesrooms all along the row, both of members and non-members of the association, were decorated with foliage.

HOLYOKE ENCLOSED CAR SHOW

HOLYOKE, Mass., Oct. 27—An enclosed car show under the auspices of the Holyoke Automotive Dealers' Association was held in the new showrooms of the Magna Auto Co., Oct. 12, 13 and 14. There were fourteen exhibitors, and the entire enterior was decorated with autumn leaves and flowers. The exhibits made up a representative display that completely filled the exhibition space. About 5000 persons attended the show and the management express themselves as well pleased with the sales.

FOREIGN DEALERS VISIT MOON

ST. LOUIS, Oct. 30—Dealers from England, Sweden and Mexico have been at the Moon factory during the past week for the purpose of arranging for immediate shipment of cars. The Swedish dealer ordered shipment of 25 cars a month and the Mexico City dealer ordered 35 a month.

U. S. Highway Bureau Gives This Figure for Total Work

Permanent Mileage Added in Fiscal Year Ending June 30, Was 10,000

WASHINGTON, Oct. 30—A total of 10,000 miles of Federal-aid highways were added to the mileage of the nation's good roads during the fiscal year ending June 30, according to compilation of the U. S. Bureau of Public Roads.

Figures of the Bureau show that the present calendar year has broken all records for road construction. The total sum spent in the United States the first nine months of this year is already in excess of $600,000,000 and will aggregate $742,000,000 for the entire year. The figures include Federal-aid roads and projects built by the States and smaller municipal units without the aid of Federal funds.

On July 1, 1921, the total mileage of completed Federal-aid highways was 7,500. There were under construction at that time an additional 18,000 miles in various stages of completion. The close of the fiscal year, this year, shows the total completed mileage more than doubled, reaching a total of 17,700 miles. Federal-aid highways under construction at the end of the fiscal year totalled 14,500 miles, which are approximately 56 per cent completed.

In Federal-aid highways, built this year, Texas leads with 933 miles. Arkansas, Georgia, Iowa, Minnesota and North Carolina, each reported more than 500. Montana and Wisconsin completed more than 400 miles each the present fiscal year. During the year 30 miles of Federal-aid bridges were built, of which the Federal government contributed 50 per cent.

LOS ANGELES TO HAVE SHOW

LOS ANGELES, Oct. 27—The first automobile show to be held in Los Angeles for two years is scheduled to open Nov. 11 and continue until Nov. 19. Because of the lack of adequate housing facilities four large tents with board floors will be used for the purpose. Exhibitors will pay $1 per square foot for the space and membership in the Motor Car Dealers' Association is necessary to obtain space for car or truck exhibitors. A section of one tent will be devoted to accessories. Because of opposition on the part of truck dealers the truck exhibit will not be segregated, but will be assigned in each tent for commercial vehicles. The objection was based upon the point that in a segregated display comparatively few visitors to the show would inspect the trucks and in order to give them an even break in the attendance the new plan was decided upon.

General Motors Sales This Year to Be About 468,355

Number of Vehicles Distributed Will Be Greatest in History of the Corporation

NEW YORK, Nov. 1—Total sales of the car and truck manufacturing units of the General Motors Corp. this year, based on actual figures for the first nine months and estimated figures for the last quarter, will amount to 468,355 motor vehicles, the greatest sales of any year in the corporation's history. This information is given in "Facts and Figures," prepared by the department of financial publicity of the G. M. C. and sent out today to the corporation's 70,000 stockholders.

The sales for each of the passenger and commercial car divisions for 1922 (last quarter estimated), as compared with the sales in the three preceding calendar years, are given in the accompanying table.

Volume of sales in dollars amounted to $218,859,267 for the first six months of this year, indicating that this year will top the previous high figure of $567,320,603 in 1920. Net sales for other years were as follows: 1921, $352,527,386; 1919, $509,676,694; 1918, $269,796,829.

The excess of current assets over current liabilities (net working capital) June 30, 1922, was $122,725,264. Cash in banks was $35,527,973. Sight drafts, $10,430,382; notes and accounts receivable, $21,899,134; inventory, $94,166,601. Current liabilities include accounts payable, $22,184,843; taxes, pay rolls, etc., $16,979,253; and accrued dividends, $1,068354.

"General Motors, since 1905, has produced over 2,000,000 passenger cars," says "Facts and Figures." "Of this number, approximately 75 per cent, or more than 1,500,000, were in use on Jan. 1, 1922. According to the National Automobile Chamber of Commerce, there are 9,300,000 passenger automobiles in the United States. To be conservative, at least one out of every seven passenger cars is a General Motors product. . . . Since one out of every seven is a General Motors car, it follows that this group carries approximately one billion passengers annually—approximately the number of passengers carried by all the steam railroads in this country."

BEATS OLDFIELD'S RECORDS

ST. LOUIS, Oct. 26—"Dick" Jennings, Jr., millionaire sportsman of Pittsburgh, this afternoon crashed his way into the automobile speed game by breaking by wide margins the 10, 15 and 20 mile world's dirt track records formerly held by Barney Oldfield. Jennings drove the Frontenac car with which Tommy Milton won the Indianapolis 500-mile race in 1921.

His time for 10 miles was 7:32 1/5, as against Oldfield's 7:56 1/5; 15 miles in 11:21 1/5 in comparison to Oldfield's time of 12:00 4/5, and 20 miles in 15:20 1/5 against Oldfield's performance of 15:52 1/5. Oldfield's marks were made at Maxwell track near here Aug. 9, 1917.

DURANT GETS LOCOMOBILE

NEW YORK, Oct. 30—By order of Referee Keogh, the property of the Locomobile Co. of America at Bridgeport, Conn., has been formally transferred by the trustees to the new Locomobile Co. of America, a New York corporation, which is controlled by W. C. Durant. This action took place last Friday and now the new interests are going ahead on the policy decided upon when Durant first took over Locomobile. The schedule calls for the manufacture of 800 cars during the 1923 season and 1,000 persons will be employed at the Bridgeport plant.

Comparative Output of General Motors Vehicles for Four Years

NEW YORK, Nov. 1—The combined sales by the car and truck divisions of General Motors in the first quarter of this year totaled 71,039; the second quarter, 135,751; and the third quarter, 109,346. This makes a total for the first nine months of 1922 of 316,136, which exceeds the full 12 months of 1921.

The sales for the year to end Dec. 31, 1922 (last quarter estimated), compared with the actual sales of the three preceding calendar years, follow:

	*1922	1921	1920	1919
Passenger Cars				
Buick	134,000	83,888	116,213	119,853
Cadillac	22,000	11,130	19,790	19,851
Chevrolet	249,000	75,667	144,502	132,710
Oakland	26,000	12,661	37,244	54,451
Oldsmobile	23,000	20,245	26,241	33,345
Commercial Cars				
Chevrolet	2,900	1,489	4,938	2,682
G M C Trucks	5,600	2,760	5,137	7,730
Oldsmobile	1,500	466	8,383	7,782
Totals				
Passenger Cars	454,000	203,591	343,990	360,210
Commercial Cars	10,000	4,715	18,458	18,194
Miscellaneous**	4,355	6,493	30,627	13,334
Grand Total	***468,355**	**214,799**	**393,075**	**391,738**

*Based upon the actual sales for the first nine months of 1922, together with estimates for the last three months.

**Includes tractors; and also cars and trucks not now manufactured.

Tire Makers Noncommittal On Rumored Price Increase

Upward Trend of Crude Rubber Causes Revision to Be Seriously Considered

AKRON, O., Oct. 30.—Akron tire manufacturers remain steadfastly noncommittal upon the report that they have under consideration an increase in tire prices which may approximate 20 per cent. In spite of their refusal to discuss the rumor, however, the matter of a tire price revision upward within the next month or so is considered probable by men close to the tire industry.

Strengthening the rumor of a price increase is the fact that crude rubber is soaring in price, having jumped from 14 cents to 23 cents a pound within the past two weeks, and that crude rubber quotations for winter deliveries show a considerably higher price which is expected to keep on increasing.

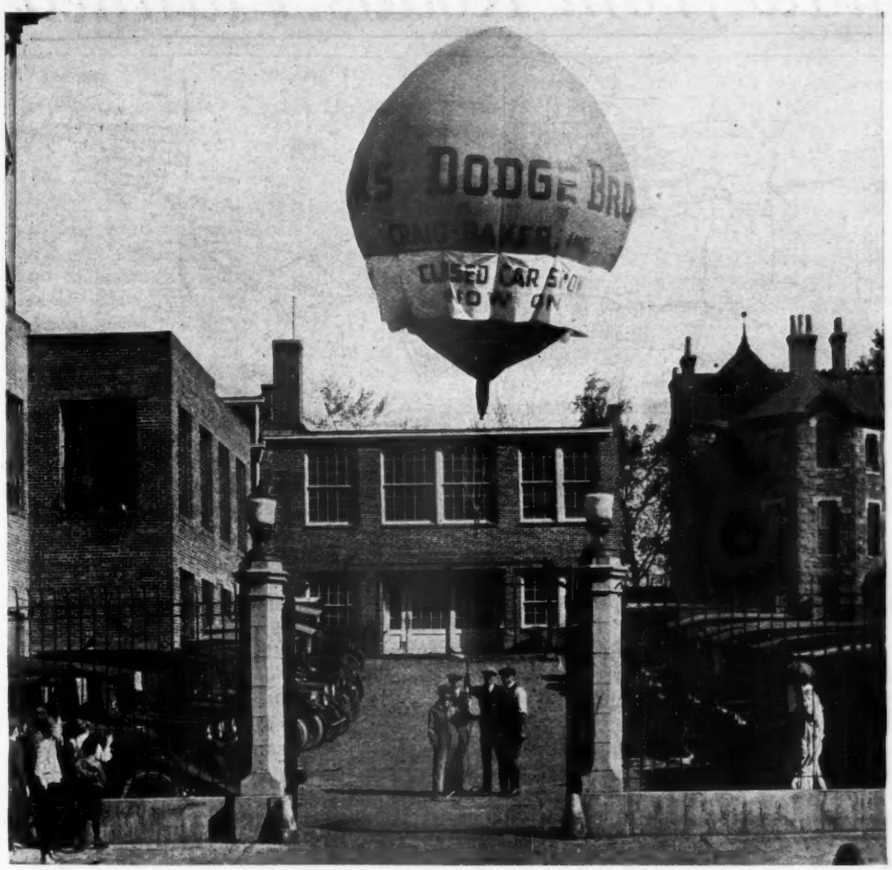
Tire prices for some months have been the lowest in the history of the automotive industry and far below pre-war price levels when tires did not give one-third of the mileage that the present day tire will average. When some companies cut prices last spring and again in the early summer, a few companies instead of following suit immediately introduced a new line of cheaper fabric and cross-rib cord tires to compete with the lowered prices of standard tires and kept their standard tires at standard list prices. This condition puts these companies almost in a position where they cannot well increase prices on standard brands of tires, whereas companies which lowered the prices of their standard casings are in a better stragetic position to revise prices upward.

Spring customarily is the time for tire price revisions, but with the crude rubber market strongly indicating a steadily rising price, it is considered very probable here that the motoring public soon may be paying more for its tires and that the increases will come before spring.

25TH ANNIVERSARY OF AUTOCAR

NEW YORK, Oct. 26—The Autocar Co. of Ardmore, Pa., celebrated its twenty-fifth anniversary last week. Louis J. Clarke founded the Autocar Co. and is still active as its vice-president. He first experimented with electric vehicles in 1890 at Pittsburgh and began his experiments with gasoline vehicles in 1895. The beginning of the Autocar Co. was in 1897, when he combined with William Morgan of Pittsburgh. The concern was incorporated under its present name in 1899 and moved from Pittsburgh to Ardmore. Passenger cars were manufactured at first, but in 1908 the company took up the manufacture of trucks and abandoned the passenger car field.

Dealer's Novel Method of Advertising Show



DENVER, Oct. 28—A balloon anchored high over head was the novel method used by Craig-Baker, Inc., Dodge Bros. dealer in Denver, to advertise its enclosed car show held in the sales room from Oct. 18 to 21, inclusive. Large lettering on the balloon announced the fact that the enclosed car show was in progress. About 3,000 persons a day visited the show and although no sales solicitation was permitted, 27 cars were sold to visitors during the show.

GMC Organizes 4 Divisions To Assist Truck Salesmen

PONTIAC, Mich., Oct. 30—As a means of increasing the co-operation between the factory and the dealer, the General Motors Truck Co. of Pontiac has created four divisions under the sales department to assist truck salesmen in all sections of the country.

The four new divisions of the truck company come directly under the supervision of the sales promotion manager and are, in turn, supervised by experts in truck statistics and sales.

The new divisions are:

The loose materials division where dealer and factory problems in the hauling of sand, gravel, ashes, garbage and any other article which can be dumped are worked out.

The bus division, where figures are prepared and problems worked out in the marketing of bus chassis for school work, interurban and city transportation.

The highway engineering division, where demonstration problems and dealers' questions are worked out. A function of this department is to help the dealers and distributors in closing sales either through the use of literature or by personal factory representation.

The statistical division, where figures are gathered on motor truck registration and many other subjects of help to dealers.

CHARLOTTE (N. C.) SHOW FEB. 5

CHARLOTTE, N. C., Oct. 30—The Charlotte Automotive Trades Association has decided on Feb. 5 to 10 as the date for the automobile show, which it was decided some time ago to stage the coming Winter. The show will be held in the Made-In-Carolinas exposition building.

PARTS BUSINESS IS GOOD

NEW YORK, Oct. 28—Reports from members of the Motor and Accessory Manufacturers Association show that sales in September, 1922, decreased 13.36 per cent over the preceding month, August, and that for the first nine months of this year the total sales amounted to $308,855,420 or $116,216,675 more than for the corresponding period of 1921.

Apperson, With New Finance, Plans to Add a Light Model

Bond Issue of $700,000 Will Provide Working Capital for Expansion

CHICAGO, Oct. 30—New working capital of $700,000 is to be provided for the Apperson Bros. Automobile Co. of Kokomo, Ind., under a plan of refinancing which contemplates the bringing out of a new light car in addition to the regular 8-cylinder model.

The new finance is to come from an issue of first mortgage gold bonds which will be offered through the firm of A. S. Terrill & Co. of Chicago. The bonds will bear 7 per cent interest and will mature $40,000 annually beginning Oct. 1, 1924, the balance Oct. 1, 1932. The trustees will be First Trust & Savings Bank of Chicago and George L. Davis, vice-president, Howard National Bank, Kokomo.

Plans Not Yet Announced

Detailed plans for the new light car are not yet ready for announcement, but it is understood that it will conform in every respect to Apperson quality and appearance and probably will be known as the Apperson Junior. It is specifically stated that the standard 8-cylinder Apperson chassis will be continued. The production for next year is estimated at 2500 8-cylinder cars and 4000 of the smaller models.

The balance sheet prepared on the basis of the new financing shows that the company's total current assets are $1,863,156.77, as compared with current liabilities of $606,073.89, or about three to one. A statement by Edgar L. Apperson, president of the company, says that the result of operation to Sept. 30, 1922, indicates a profit for the year ending Dec. 31 exceeding $300,000. Average annual earnings for the five years, 1916 to 1920, inclusive, are given as $199,-238.96. The loss for the year 1921, after writing off depreciation of industry, is given as $9311.30. The parts business is said to amount to over $300,000 a year.

The purpose of the bond issue, as stated by Apperson, "is to provide for additional models and add to working capital." The bond issue will be secured by a closed first mortgage covering all plants, real estate and fixed assets of the company.

LARGE TIRE PROFITS

AKRON, O., Oct. 28—With net profits of $5,000,000 for the first eight months of the year, it is expected the Firestone Tire & Rubber Co. will close its fiscal year Oct. 31 with net profits of between $7,000,000 and $8,000,000. The company has had a good season. Starting with a production of 23,000 tires a day, production went as high as 28,000. It has been running slightly in excess of 26,000 since then.

Removal of Snow from Roads Planned

Federal Bureau Asks States To Provide Necessary Labor

Government Ready to Supply Equipment Free of Cost From Surplus War Stocks

WASHINGTON, Oct. 28—Preliminary reports made to the United States Department of Public Roads on its snow removal program, announced last week, in MOTOR AGE, indicate that the northern states will co-operate in the Department's efforts to keep the main arteries of automobile traffic clear of snow.

The need of such cooperation has been pointed out by the Bureau of Roads, citing figures of the National Automobile Chamber of Commerce, showing the driveaways from the automobile manufactories coupled with the fact that the railroad car service reports indicate an increasing shortage of surplus cars to handle not only the automobiles shipped but other freight.

The railroads this coming winter, the Bureau declares, will not be able to handle the traffic in the more congested districts, which include Detroit and eastern automobile manufacturing establishments. The need for open highways is more pressing this year than in any previous year of the automobile industry, it is declared.

State Asked to Supply Labor

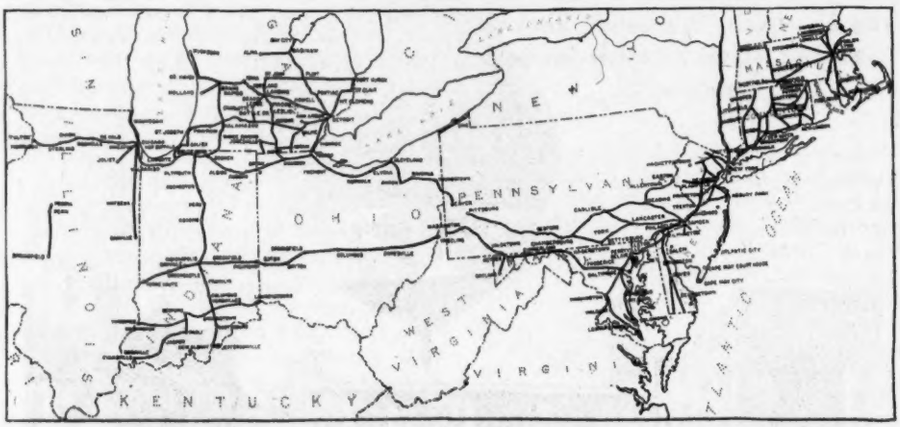
State Highway officials have been asked if they can arrange to supply the necessary labor to man snow shovels, provided the Bureau of Public Roads will furnish the necessary equipment, which the Bureau has agreed to do, out of surplus war stocks of road equipment.

Tentative routes in Michigan, Illinois, Indiana, Ohio, Pennsylvania, Maryland, New Jersey, New York, Massachusetts, Connecticut have been mapped out by the Bureau and these have been submitted to the highway officials.

Efforts at a snow removal program in the past have failed in actual application because of the failure of certain highway officials to cooperate and interstate highway transportation has been made impossible because of certain stretches of highways that were impassable.

Under the existing Federal laws none of the moneys appropriated by the Federal Congress can be used in snow removal work, but the emergency can be met, it is stated, by the Bureau of Public Roads furnishing the equipment, free of cost, and the states furnishing the labor to perform the work.

The State officials have been requested to submit figures showing the approximate cost, based on the number of miles of highways which must be kept open if adequate highway transportation is to be maintained.



Map showing main highways which the Federal Bureau of Public Roads proposes to keep free from snow this winter, providing the states will cooperate by furnishing the labor

These figures are being compiled by the Bureau, under the supervision of H. K. Bishop, chief of the Division of construction.

Under existing conditions, figures furnished by the Traffic Department of the N. A. C. C. show, automobile manufacturers must ship the greater part of their product by rail during the bad winter seasons, because of the sole fact that the highways are impassable during the snow seasons in the northern states.

The percentage of driveaways from the factories, the figures show, are very high during the summer months, because of the fact that automobile agencies and manufacturers alike, find it advantageous to move their product via the highways rather than rail.

September shipping reports from factories, making 80 per cent of the total automobile production, indicate a total of 26,288 carloads of automobiles shipped via rail, 30,322 driveaways and 8,754 shipped by boat. If the snow-removal program for the coming winter can be inaugurated officials of the N. A. C. C. declare that almost the same percentage of driveaways can be maintained as during the summer months.

In the event of further car shortage, the percentage of driveaways, it is pointed out, would be materially greater and under the plan, the automobile industry would not be so greatly hampered in the event of a car shortage.

Details of the program will be announced by the Bureau as soon as the reports from the various state officials are received.

75 Truck Distributors at Federal Factory Convention

DETROIT, Oct. 27—Federal Motor Truck Co. received orders from distributors at its annual sales convention last week in excess of 300 for immediate delivery, and looks for a steady stream of business through the winter months. The factory now is operating at better than 50 per cent of its normal capacity and is rapidly getting into production on its new light models. Buying from the farm districts is light but is improving.

M. L. Pulcher, vice president and general manager of Federal, predicted that the next five years will be the most prosperous era the truck business has known. Dealers who have been through the depression of the past two years are about to cash in, Pulcher said.

F. L. Pierce, general sales manager, pointed out to the convention the strength of the Federal sales organization, declaring that in addition to the 75 distributors present, it had 600 dealers. L. B. Dudley, advertising manager, outlined the company's advertising program, and R. H. Crooker, sales promotion manager, told of plans to aid dealers.

The convention closed with a dinner at the Detroit Athletic club, at which F. W. Fenn, chairman of the motor truck committee of the N. A. C. C., spoke. An inspection trip to the Muskegon plant of the Continental Motors Corp. followed the dinner.

RECEIVER FOR GRANT COMPANY

CLEVELAND, Oct. 28—Joseph C. Hostetler, member of the law firm here that is headed by former Secretary of War Newton D. Baker, has been appointed receiver for the Grant Motor Car Co.

Creditors of the corporation are asked in the bill of complaint to send in their claims. The plant will be closed for a short time for inventory, but the receiver has authority to operate the plant and this will be done, with the view to working out the company's salvation under the protection of the United States District court.

85 AT McQUAY-NORRIS MEETING

ST. LOUIS, Oct. 30—More than 85 field men, branch managers and executives attended the annual sales conference of the McQuay-Norris Manufacturing Co. here Oct. 16 to 21. This year has been the most successful in the company's history, it was said, and the outlook for the future was bright.

California Trade Association Reorganized on Quality Basis

Dealers Favor Education for Mechanics—Battery Crafts Opposed to Free Service

SANTA BARBARA, Cal., Oct. 31—The California Automobile Trade Association, an organization of more than 3,000 firms and individuals in the automobile, motor truck, equipment, repair, service and garage branches of the automotive industry, was thoroughly reorganized and put on a new business basis of operation at the annual convention in the Arlington Hotel here Oct. 16 and 17. More than 80 delegates, representing as many local branches of the association, took part in the convention, and Bakersfield was selected as the place for the next annual meeting in October, 1923, exact date to be selected later.

Purposes of By-Laws

Reorganization was accomplished along lines important to both the men of the automotive industry and to all the motorists of California. For the first time in the seven years of the existence of the California Automotive Trade Association, by-laws were adopted, forming the basis of the reorganization. These by-laws were written and adopted with the express purpose of:

(1) Increasing the confidence of the public in the members of the association, and improving the standards of dealing with the public by these members;

(2) The elimination of the undesirable member; the establishment of a membership based on quality, rather than quantity; the removal of the member who does not support and take part in the work of the association, and the taking away of the backing of the association from those men in the industry who do not deal honorably with the public.

It was brought out that, of the more than 3,000 members of the association, hardly more than one thousand were in good standing. Authority was given in the new by-laws for the elimination of these members, and the watchword, "Better quality and smaller quantity," in membership, was adopted.

Following the adoption of the by-laws, the following officers were elected, to serve for one year:

Harry S. Mason, Los Angeles, president; George Dunton, of Anaheim, vice-president for the south; U. S. Grant, San Diego, vice-president for the south; George R. Murphy, San Francisco, vice-president for the north; Walter Fawcett, vice-president for the north; Robert W. Martland, secretary-manager and treasurer.

H. C. Brokaw, chairman of the Garage and Repair Craft, presented a report urging the licensing of mechanics, as remedy for the "curbstone" or fly-by-night mechanic, "who," says the report, "is a damaging factor at present combatted only by the co-operation of the automotive associations with the city councils and the police." The bonding of employes also was suggested. The meeting in general seemed to oppose the licensing of mechanics, but to favor the education of mechanics by courses in connection with public schools, either day or night, or in classes to be addressed frequently by factory representatives, and men named for the purpose by the manufacturers of automobiles, trucks and equipment.

Battery Crafts Report

The battery crafts, which had sent the largest group of delegates to the convention, likewise presented the most interesting report, through J. G. Brown, of Los Angeles, chairman. Brown declared that free service had been eliminated in the automotive industry except in the business of the battery men. "All factories," said he, "favor a service charge. San Francisco dealers polled their trade on this question, and the majority of the customers were in favor of a reasonable charge for good service."

Indianapolis Dealers to Help Stage Indiana Convention

Financial Backing to Be Given State Association to Aid Success

INDIANAPOLIS, Oct. 28—The directors of the Indianapolis Automobile Trade Assn. have decided to co-operate with the Indiana Automobile Trade Assn. in the convention and banquet of the state body here in December. Substantial financial backing is to be given the state body in order that the convention may be as great a success as possible. Members of importance to the automotive trade of the entire state are expected to be considered by the Indiana legislature, which meets early in 1923. It is considered vital to the interests of the automotive trade of the state that the dealers of the entire state meet at the convention and discuss the problems that confront the industry and trade.

Second Joint Meet

This is the second time that the local association has given substantial support to the state body. At the organization of the state association the local body financed the original state convention and banquet, and aided in many ways in launching the state association. At that time local distributors as a whole had financial dealing with every part of the state. Since that, changes in distributing plans have lessened the distributing importance of Indianapolis. Consequently the substantial report being given the state work is a far more splendid example of unselfish service for the automotive trade at large. It is expected that D. C. Barnett, secretary of the state association, will shortly announce the exact date of the convention and of features that will give the affair appeal to all dealers.

California dealers at their annual meeting at Santa Barbarba

Accessory Sales Reach High Level in Southeastern States

Tools, Machinery and Equipment in Demand As Many New Shops Are Opened

ATLANTA, Ga., Oct. 30—Several of the larger automotive equipment jobbers in Atlanta, with salesmen covering the various southeastern states, advise that wholesale accessory business in this district has increased steadily from month to month since early spring, with August, September and October sales about on an equal basis with the best months of 1920, when accessory sales were at the high water mark in this section. Among the wholesalers who are authority for this statement was E. H. Baughman, vice-president of Ozburn-Alston & Co., of Atlanta, one of the South's largest jobbers and president of the Southeastern Automotive Equipment Assn.

Tool, machinery and miscellaneous sales to garages and service stations over the district have been particularly good, with this business in greater volume at this time than it has ever been, as an unusually large number of service stations have been established the past three or four months over the Southeast. Gross business in service stations and garages, automobile distributors here advise, is also on a par with the best months of the inflation period immediately after the war.

The outlook is for a steady volume of profitable business all through the winter months.

As to tire sales, distributors here covering southwestern territory advise conditions substantially the same as reported above for accessory and equipment sales, with particularly good business in heavy truck tire sales.

The principal improvement in all sales has been in the smaller towns and communities dependent largely on rural business.

APPLETON TAKES OVER RELIANCE

APPLETON, Wis., Oct. 30—The Appleton Motor Truck Co., which recently was incorporated with $50,000 capital, has for its purpose the taking over of the plant and business of the defunct Reliance Motor Truck Co. of Appleton, manufacturing the Reliance truck, Badger truck axles and other truck parts. The Reliance company was forced into bankruptcy by lack of working capital early this year. At receiver's sale the entire property was acquired by a group which incorporated the new company. The officers are: President, A. G. Brusequitz; vice-president, John Heenan; secretary, William Geenen; treasurer, Matt Rossmeissl. In addition to resuming the production of Reliance trucks and axles, the new concern plans to manufacture power farm implements and will start with a check-row potato planter.

Olds Representatives at Service School at the Factory

DETROIT, Oct. 27—Automobiles will be the principal medium of transportation in the near future, President A. B. C. Hardy of the Olds Motor Works, told the service managers gathered at the factory last week for the annual convention. It will rank next after food, clothing, housing and the telephone in importance in the life of the people, he said. Startling improvements will be made in the next five years, he declared, making for economy, lighter weight and increased power.

Other talks at the convention were by R. M. Hatfield, factory service manager; C. F. Kettering, president of General Motors Research Corp.; R. K. Jack, chief engineer at Olds, and Thomas O'Brien, assistant sales manager.

An exhibit of parts illustrating mechanical features of the Olds models will be made a permanent exhibit to promote the development of service at all times when dealers or service men visit the plant.

INDIANAPOLIS SHOW NOV. 6 TO 10

INDIANAPOLIS, Oct. 26—The Enclosed Cars Fashion Show of the Indianapolis Automobile Trade Assn., to be held Nov. 6 to 10, inclusive, will have 24 exhibitors. For the first time in connection with any Indianapolis show the local association is obliged to confine exhibition to members of the body, space limitations in the downtown building where the show is to be held making it impossible to accommodate all dealers who would like to display enclosed vehicles. Plans to stage affair on a very high plane are being laid, and decorative and musical features are being developed with this end in view.

REVERE SALE POSTPONED

LOGANSPORT, Ind., Oct. 25—It was announced today by Judge Paul M. Souder that the court would hold up the sale of the Revere automobile plant until the middle of next week. Up to date but one bid has been received, and there seems to be some question as to the action the court will take on this bid if no others are received. The plant of the concern will be closed tonight, according to officials representing the receivers.

TRACTOR ON LONG TOUR

WATERTOWN, Wis., Oct. 30—One of the longest cross-country tours ever made by a tractor is that now nearing its end at New Orleans. On Oct. 8, a Monarch tractor, manufactured by the Monarch Tractor Co. of Watertown, left the factory with greetings from city officials and the chamber of commerce. The tractor is driven by "Blondy" Sorenson, and is preceded by E. L. Woods, sales manager of the company, in a touring car. At Madison, Wis., the governor and other state officials signed the log, and the same is being done at all other state capitals through which the unique caravan is passing. Demonstrations are being made at frequent stops along the route. A report of the tour, with a complete log, will be made at the National Good Roads Show to be held in Chicago, Jan. 15-19, 1923.

95,126 FORDS MADE IN SEPTEMBER

DETROIT, Oct. 25—In September the Ford Motor Co. produced a total of 95,126 cars and trucks in the home and foreign plants in comparison with 136,132 in August. Of this total, the six foreign plants turned out 5369 and Canada 3511. Ford was shut down four days in September.

Including September, Ford's production so far this year totals 925,325 and it is expected the full year will produce 1,300,000.

A CORRECTION

Owing to an error in composition, the advertisement of the Manley Manufacturing Co., of York, Pa., in MOTOR AGE of October 26 gave the price of the garage flood light as $14. The correct list price is $15.

Ford's Reduction Creates New Owners, Says Jordan

Believes 2,000,000 More Persons Will Become Automobile Kindergarten Students

DETROIT, Oct. 28—Edwin S. Jordan, president Jordan Motor Car Co., addressing Purchasing Agents' Assn. of Detroit here, stated that automobile manufacturers who are to prosper in the future will be those who carefully choose their material with reference to quality rather than price. He deplored the practice in some organizations of allowing price to govern entirely in their purchase of materials and parts and graphically depicted the manner in which concerns that have been governed this way in the past have gone downwards in their production curves and, as he stated, "passed out of the picture."

Commenting on Ford's recent price cut, Jordan stated that this created 2,000,000 more students in the kindergarten of the automobile business. In other words, it brought 2,000,000 more car owners into the field, and, consequently, is of the greatest benefit to the entire industry.

Regarding future prices of other makes, he stated that the next two or three years would find prices declining at intervals, in spite of the fact that in the spring of 1923 a tremendous shortage of automobiles would exist. Drawing a pitcure of the progress of the automobile industry to-date, he pointed out that it has gone through five distinct phases, the first of which was when the engineer controlled the entire business. In the early days, he said, the engineer or mechanic would deal with the rich, young sport in the neighborhood and, consequently, became the automobile dealer. The first dealers were mechanics. The second phase of the industry was when the production manager began to become a dominant factor. The ability to manufacture a good automobile in quantities was the criterion of success during this second period. The third phase was that of the sales manager, in which the ability to sell the product was the paramount necessity for success. The fourth phase, Jordan stated, was that of service and finally we have reached the fifth phase in which the owner has become the dominant figure and a company, to succeed, must build a car which pleases the owner.

WHOLESALE THEFT FOILED.

DETROIT, Oct. 27—Local police believe that they have captured the head of a gang that has stolen many high priced cars recently and planned to steal 4,000 more during the coming year.

Early this fall Edward J. Sweeney, the prisoner, went to New York, it is said, and presented an option on the purchase of 4000 Cadillacs of an older model at an extremely low price which he said was given him by the General Motors Corp. His explanation was that Cadillac planned to produce a new model that would make the present model obsolete and the cars he had option on would be made from parts of the present model. The cars were to have used tires and speedometers registering 500 to 1000 miles to prevent dealer antagonism.

A sample car shown to O. B. Richards & Co. interested them into offering $4,600,000 for the lot. An attempt to insure the sample car which a friend of the firm bought, caused suspicion which resulted in the arrest of Sweeney under the Dyer Act. The arrest was made when Sweeney kept an appointment at which he was to receive an initial check for $100,000.

Automobile Is Stolen From Dealer's Show Room

MADISON, Wis., Oct. 28—The very latest in motor car thievery is reported by the Jacobson-Austin Co., 207-211 East Washington Avenue, Madison, Wis. A new Cadillac phaeton, valued at $3,500, was stolen out of the display windows between Sunday evening and Monday morning. The car was recovered at Hebron, Ind., two days later in possession of Theodore Thiel of Columbus, Wis., who is in custody. The theft of the machine was not discovered until employes of the Jacobson company came to work Monday morning. The front door of the garage had been unlocked and the Cadillac backed out of the window, it being necessary to move several other display cars to get it through the service floor. It was then driven out of the alley at the rear, almost directly across from the police station. Thiel is held on the charge of operating a car without the consent of the owner. He insists he purchased the car from a stranger. When arrested in Indiana he had in his possession Ohio state license plates.

SPRINGFIELD, O., PLANTS BUSY

SPRINGFIELD, O., Oct. 27—Production has been increased at the plant of The Kelly-Springfield Motor Truck Co. F. H. Peitsch, acting general manager, states that the plant is running heavy on parts. There is a general demand for parts from dealers and others. Peitsch has just returned from a trip to Chicago and other points in that territory. Conditions are encouraging for the sale of trucks, he states.

"This is the best week on shipments we have had," said Earl Heinzer, of The Westcott Motor Car Co., in speaking of business at this plant. "Production is increasing steadily. We hope to maintain this schedule throughout the fall."

Among the driveaways from the Westcott company's plant were several to long distance points including Boston, Washington, D. C., Pittsburgh, and St. Louis. Returning from a trip through the East E. H. Gilcrest, general sales-manager, states that prospects are bright for sales in that section.

Automobiles Made in 1921 Valued at $1,166,140,189

U. S. Census Figures Place Volume of Output 30 Per Cent Less Than in 1919

WASHINGTON, Oct. 26—Automobiles manufactured in the United States during 1921, including all classes, had an aggregate value of $1,666,140,189 and were 30.2 per cent less than the values of the automotive industry in 1919, when $2,387,903,287 worth of passenger cars, trucks and other vehicles such as public conveyances, ambulances, fire apparatus, patrol wagons, etc., were produced, according to census of the automotive industry for 1921 just completed by the Bureau of Census.

The figures show that during 1921 there were 368 automobile manufacturing establishments, representing an increase of 15.4 per cent in the number of automobile manufacturers over 1919, when there were 315 manufacturers. These figures represent only the manufacturers whose chief products were assembled automobiles and do not include establishments engaged primarily in making bodies, parts and automobile accessories.

Decrease Is Shown

The number of completed automobiles turned out during the year shows a decrease from 1,868,310 in 1919, valued at $1,722,626,704 to 1,585,395 in 1921 valued $1,320,175,169.

The decrease in the total value of products was 30.2 per cent and in the number and value of automobiles manufactured, 15.1 and 23.4 per cent respectively.

Of the 368 establishments reported in 1921, 64 are located in Michigan, 50 in Ohio, 39 in Illinois, 30 in Pennsylvania, 28 in Indiana, 26 in New York, 25 in California, 19 in Wisconsin, 12 each in Massachusetts and Missouri, 8 in New Jersey, 6 each in Iowa and Texas, 5 each in Kentucky, Minnesota and Washington, 3 each in Connecticut, Georgia, and Oklahoma, 2 each in Colorado, Nebraska, North Carolina, South Carolina and Virginia, and one each in Alabama, Arkansas, District of Columbia, Louisiana, Maryland, New Hampshire, Oregon, Tennessee, and West Virginia.

ASKS DEALERS FOR SUGGESTIONS

CHICAGO, Oct. 30—Automobile dealers and other automotive merchants who are members of the Chicago Automobile Trade Association have been requested by the association to suggest new activities they would like to see undertaken or to offer any criticism they believe to justified. The letter making this request was accompanied by a headed sheet of paper upon which to write the suggestion or criticism.

Lack of Garage Space in Cities Hampers Car Sales

Colin Campbell Tells Chevrolet Dealers Conditions Retarding Business Must Be Removed

DETROIT, Oct. 28—Lack of garage space was declared by Colin Campbell, general sales manager of the Chevrolet Motor Co., to be a restraining influence against greatly increased volume sales of cars in congested eastern cities. Such conditions were, he said, holding back the immediate sale of approximately 100,000 cars in New York City alone.

Architects, engineers and civic authorities should begin to take the transportation needs of the public more into consideration in developing plans for apartment buildings, office buildings, civic structures and highways, he said. Modern apartment buildings in congested districts should have three or four subcellars with ramps to provide for car storage if such buildings are to meet tenant requirements of the future. Multiple deck streets already are a crying need in many cities to adequately provide for traffic and car parking. People requiring cars and who are greatly in need of cars would go into the market faster to buy cars were proper storage facilities or garage space available at proper rental.

"No Saturation Point"

His remarks on traffic and garage conditions were in refutation of the possibility of any alleged saturation point for automobiles being near or possible, and further stated that the limiting factor of the industry, if it ever occurred, would be entirely governed by the capacity of our highways and streets in the large cities. He further remarked that but 7 per cent of the highways in this country were improved at the present time and that the industry, aside from its natural normal growth each year, would also have to grow with the highways as they were improved.

Campbell addressed Chevrolet dealers of zone No. 1, which consists of the states of Michigan, northern half of Indiana and northern half of Ohio, at a sales meeting in the Hotel Statler, in which he outlined the business possibilities of the new Chevrolet line. Dealers should awake to their opportunities, he said, and where conditions such as outlined above are retarding sales, the dealers should take an active part in assisting to correct them.

Bankers attending the meeting with dealer clients were addressed directly by Campbell in a request for co-operation for the automobile industry as represented by automobile dealers in their respective localities, and he brought particularly to the attention of the banking interests the relative importance of the industry to the business and social life of the entire nation.

Armed with statistics from government bureaus, Campbell pointed out that the business of the country as represented by bank clearings had trebled since the dawn of the automobile era 20 years ago, as compared with the previous 45 years, and in a like period, he said, American business since 1900 would show an increase of approximately 1,000 per cent. He pointed out that the automobile industry, as representing individualized transportation today, was one of the four essentials of civilization—food, clothing, shelter and transportation.

Dealers should justify the confidence of the bankers by setting their own business in order, he said, and where dealers have not had sufficient capitalization to properly conduct their business from a credit standpoint they should prepare immediately to remedy such condition.

Figures were quoted giving the sales that were made at the week's showing of the Chevrolet Superior models at their Detroit store, all of which business was conducted without accepting trade-ins. On trade-ins, he urged the Chevrolet dealers to be careful and to make certain that what goods they traded in were of the character that permitted of ready sale.

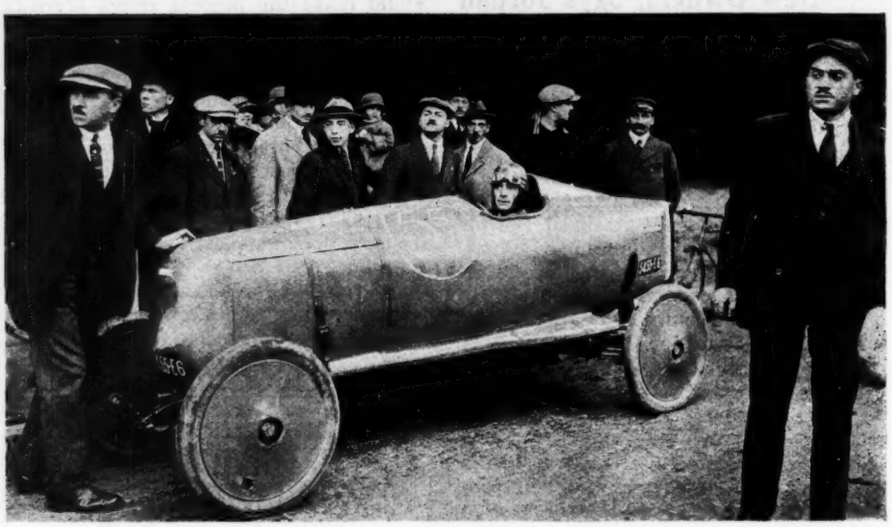
"Salesmen, Not Buyers"

"Remember you are salesmen and not buyers," he said, "and conduct your business on that basis. No good dealer will allow himself to be enticed into any unfavorable deal." The policy of the Chevrolet company is to conduct its business through dealers, he said, and in this connection it has eliminated practically all factory stores, as it believes that the manufacturer of such goods is essentially a wholesaler and not a retailer. The two large stores, one located in the General Motors building at Detroit and the other in the General Motors building at New York, always would be continued, as they are showrooms not only for the public but for the trade.

Morgan D. Douglas, zone sales manager, was present from the Flint factory and told of plans the company has of improving dealers' sales rooms and putting them on an efficient basis, especially those of smaller cities. Electric signs, good show windows and attractive surroundings were an important aid to business, he said, and the company is endeavoring at this time to show its dealers how to effect such changes economically. Sixty-two dealer headquarters in zone No. 1 are undergoing improvements under this plan at the present time.

Similar meetings are being arranged to be held in all zones of the Chevrolet selling organization in the near future.

94.9 Miles Per Hour Made by Salmson



An average speed of 94.9 m.p.h. was made by this car recently, it being in the 67 cu. in. class. It is a four-cylinder, water-cooled Salmson. The performance was made in the Bois Du Bologne, Paris, and was timed by the Automobile Club of France.

FAIR BUSINESS IN IOWA

DES MOINES, Ia., Oct. 28—With but few exceptions, dealers and distributors in Des Moines experienced a good business during the present month. The weather has been fine and business seems slightly better than in September. Enclosed cars are selling well, especially in the cities of Iowa.

All the Ford dealers are doing a good business and the recent price reduction seems to be bringing in many orders.

The Chevrolet dealers say they have booked many orders for the new models, but only demonstrators are to be had to date.

Although tire competition is keen, the three local factories report fair business. Several of the distributors and factory branches report a gain in business in the last few weeks.

RECEIVER FOR VAN KERR CO.

CHICAGO, Oct. 30—A petition in bankruptcy has been filed in Federal court here against the Van Kerr Co., manufacturers of spark intensifiers for use on spark plugs. Fred E. Hummell was appointed receiver.

BUSINESS NOTES

A direct factory sales and service station of the Signal Truck Corporation has been established in Indianapolis at 431 North Capitol avenue with J. T. Crossland, a veteran Signal sales man, in charge. A very complete service plant has been established at the new headquarters.

Trexler Co. of America, makers of various "Trex" automobile accessories, Philadelphia, has increased capital stock from $200,000 to $1,500,000, underwritten by George A. Huhn & Son, members of the New Stock Exchange.

The Kratz Auto Electric & Carbureter Co. of Montgomery, Ala., have recently announced the completion of their modern laboratory for the repairing and rebuilding of all makes, types and sizes of generators, starters, magnetos and electrical devices. They will, also, rewind all makes of armatures, field coils and motors.

Work is under way upon the new home of the Storage Battery Service Co., Inc., 518-528 West Fourth street, Davenport, Iowa, and will be completed April 1. Floor space will be double that of the present location, 423-425 West Second street. Chris G. Behrens is president.

W. J. Doughty, President of the Detroit Air Cooled Car Company, reports that rapid progress is being made in preparing their plant at Wayne for production equipment. It is the intention to remove the Company's office from 3745 Cass avenue, Detroit, to Wayne, within 45 days.

Excavation has begun for the Central Motors Co's. new garage on North Cherry street, Galesburg, Ill. It will be 60x100 feet, one story high with show room for the Paige and Jewett cars which the company represents. W. P. Martin is head of the company.

Production by the White Company has been steadily increased until its plants are now operating at their capacity of 10,000 trucks annually. The company reports unfilled orders sufficient to keep its plants busy for at least two months, with new business continuing large. The management has reduced bank loans from $9,000,000 to $500,000 and cash in hand is about $2,500,000. No new financing will be required to carry out the company's policy of expanding production as fast as conditions warrant.

The Kohler Co. of Kohler, Sheboygan county, Wis., manufacturer of farm lighting plants and enameled sanitary ware, has started work on another large plant addition, 70x160 ft., four stories high. Both departments of the business are making excellent progress and the plant is so crowded with orders that immediate relief by extensions of buildings is necessary.

Distribution of the Thomart Speed Truck for the entire Eastern portion of the United States has been taken over by Eastern Thomart, Inc., 90-92 Bigelow street, Newark, N. J.

The Norma Company, Anable Ave., Long Island City, N. Y., has acquired the American patents and business of the Hoffman Manufacturing Co. of Chelmsford, Essex, England, makers of Hoffmann roller, ball and thrust bearings.

Benjamin Harrison, John W. Gamble and Thomas McShane are the incorporators of the American Machinery & Supply company at Omaha. The capital stock is $50,000.

A capacity for manufacturing 100 bodies a day is provided by the new paint shop and trimming works established by the Mitchell Motors Co., Inc. at Racine, Wis. The building is four stories high, 93x320 ft. in size, and is regarded as a model plant of its kind. The building itself is closed air-tight. Incoming air is forced to pass through washers to regulate the humidity and supply clean air for the paint and varnish rooms. Individual "weather machines" for each dry room provide heat and automatically furnishes the desired percentage of humidity. A slight pressure is maintained throughout the plant at all times, this preventing inward leakage of dust and dirt around doors and windows. Each department also has perfect natural illumination, which when needed is supplemented by special electric lamps.

The Vesta-Omaha Battery Co., at Omaha, has been purchased by William J. Powers and C. F. Gruenig. The name of the company has been changed to the Omaha Battery Company.

The Terner Metal Specialty Co., of Milwaukee, has been incorporated with a capital stock of $10,000 to engage in the production of metal specialties for the automotive industries and general distribution. The incorporators are Edward W. Meldman, 1324 Galena street, Monroe J. Morse, and Attorney Robert A. Hess, 603 Caswell Block, Milwaukee.

Bnick Sales Co. has been incorporated at Fort Dodge, Ia., with a capital of $50,000. J. W. Porter is president; and W. J. Whalen, secretary and treasurer.

Landers Motor Sales Corp., 4641 Washington Blvd. has been incorporated at Chicago to deal in automobiles.

Automobile Wash Bowl & Service Co., 139 N. Clark street, has been incorporated at $50,000 to operate filling stations and laundries for automobiles.

Chicago & Joliet Transportation Co., 301 N. Ottawa street, Joliet, Ill., will deal in and manufacture automobiles and accessories. The firm's capital is $15,000.

The Akron Motor & Manufacturing Co., has been chartered at Akron, O., with a capital of $50,000 to manufacture accessories and motors.

The Lemmon Auto Supply Co., Wooster, O., has been incorporated with a capital of $50,000 to deal in all kinds of accessories and supplies.

The Wear Ever Patch Mfg. Co., is one of the new concerns of Columbus, O., which has a plant at 140 North Fourth street, for the manufacture of a new style of tube patch. The retail concern is located at 218 East Long street, where a general tire sales and repair business is carried on.

The Wayne Tank Co., Fort Wayne, Ind., has put a fotball team into the field this fall which is meeting all the best professional teams of the middle west. The team has aroused great enthusiasm among the workers at the plant.

The Tokheim Athletic Association of the Tokheim Pump Co., Fort Wayne, Ind., has been organized with A. G. Lepper as president and has sarted an elaborate fall and winter program.

Work on an addition to the plant of the Takheim Oil Tank & Pump Co., Fort Yayne, Ind., to cost approximately $100,000 will be started at once. The new structure will be 350 feet by 150 feet in size, one-story, brick and concrete fireproof.

CHANGES IN SAN FRANCISCO

SAN FRANCISCO, Oct.27—Several business changes have been made among the dealers in this city during the past week or ten days. A retail truck department, with showrooms and repair station, has been opened by R. Jackson Jones, western representative of the Traffic Motor Truck Co., of St. Louis. W. L. Wheeler has been named manager of the retail department, which is located on Polk street.

The Christensen-Davis Motor Co., has been named distributor of the Dort, according to announcement by H. P. Federspiel, district manager for the Dort Motor Co., here.

The Anderson-Smith Company, distributors of the Chevrolet, have just opened their first branch salesroom and service station in San Francisco.

PIERCE-ARROW SALES RECORD

BUFFALO, N. Y., Oct. 28—Fall sales of Pierce-Arrow passenger cars are continuing their upward curve, according to announcement made by Myron E. Forbes, vice-president of the company. Total sales made during the month of September were the greatest made in any September since 1915, showing a 150 per cent increase over the total of a year ago.

Indicative of the increase in volume of business is the fact that September orders showed an increase of 10 per cent over the previous month, which was the biggest August in the history of the Pierce-Arrow company.

The company's plant at Buffalo, N. Y., is running on a full time production schedule to keep pace with the accelerated demand for Pierce-Arrow cars.

Fortified Automobile Caravan to Explore the Sahara Desert

Andre Citroen Organizes Expedition to Spend a Year in Bandit-Infested Country

NEW YORK, Oct. 28—Approved by the French government, which will send official observers, an automobile caravan is being organized by Andre Citroen, prominent French automobile manufacturer, for an exploration of the Sahara desert, according to a copyrighted cablegram to the New York Tribune.

Cars Are Moving Fortresses

Citroen has built the cars which really are moving fortresses, being armored and equipped with the well known caterpillar tread as were the tanks in the war. This protection is necessary because of the bandits who infest the desert. The expedition which will start about Dec. 1, will be divided into three sections. The first will carry machine guns, mounted in armored cars, the second will carry the food supply, sufficient for a year, and the third the gasoline, water and spare parts.

The desert trip will be through country unknown to white men and it is believed will produce scientific results of interest and it is hoped by the scientists who will be in the party that ruins of prehistoric cities may be discovered.

COAST TRAFFIC CONFERENCE

PORTLAND, Ore., Oct. 23—Uniformity of traffic laws for the Pacific coast and Rocky mountain states, together with British Columbia, appears as a possibility on the horizon as a result of a conference held here this week, in which motor vehicle administrative officials of the various states, judges and enforcing officers participated.

After two days of discussion of the various subjects relative to motor vehicle legislation and law enforcement the session closed with the formation of an executive committee empowered to aid in drafting possible now legislation relating to traffic in the six western states and British Columbia, and to assist lawmakers of the various states in the study of the traffic problem and the passage of desirable codes.

DEALER'S EMPLOYES HAVE CLUB

PHILADELPHIA, Oct. 27—The Neel-Cadillac Club, composed of employes of that company, has been reorganized with the following officers for the year: Joseph Comly, president; C. Emory Williams, vice-president; Miriam Lichty, secretary; Hugh McHenry, treasurer; directors, the foregoing and Harry M. Gilmore, W. J. Neel, W. P. Smith, Miss Miriam Dee and Harry Ettinger. A program of social activities for the season has been planned. Chief among these is a Hallowe'en party to be held on the night of Nov. 4.

IN THE RETAIL FIELD

Michael Johannes, West Bend, Wis., has plans for a new public garage and service building, 57x87 ft., part two stories, estimated to cost $17,000.

Frank Nanscawen and Ed. T. Rippey of Hartford, Wis., have formed a partnership to act as Gray dealer. Rippey is owner of the Rippey Garage and this will be headquarters of the new firm.

St. John Motor Car Co., Appleton, Wis., has been incorporated with a capital stock of $25,000 by W. H. St. John, Geneva St. John and Clarence St. John, to operate a new garage and service station being erected at College avenue and Locust street. The same interest have conducted a sales and service business in Green Bay, Wis., for several years.

Rahr-Nash Co., Manitowoc, Wis., is a new $25,000 corporation organized by William Rahr, W. S. Schroeder and Niels Rahr to act as Nash and LaFayette dealer in Manitowoc county.

Anton Koberstein, proprietor of the Gem City Garage, Baraboo, Wis., has admitted as partners Carroll Hackett of Eau Claire and Schuyler Mather of Baraboo. The name of the firm has been changed to Gem City Garage and Filling Station.

Adolph Sommer, Cleveland, Wis., proprietor of the Sommer Garage, has established a rural community garage three miles south of Cleveland, on state trunk highway 17.

Nichols Auto Repair & Paint Shop, Rhinelander, Wis., has changed its name to Nichols Regrinding Co It has installed considerable new equipment and henceforth will specialize in gas engine repairs.

O'Neil Oil & Paint Co., 297 East Water street, Milwaukee, has been awarded the gasoline and oil franchise in the new Sixth Street Garage under construction on Sixth stret, between Grand avenue and Wells street, Milwaukee. This will be purely a storage garage, without the usual repair shop facilities. The building will be six stories, 102x150 ft.

William O. Crabtree, formerly representing the Bethlehem and Republic trucks, succeeds Glen A. Tisdale as New York representative of the Franklin. Crabtree will take over the Franklin agency and act as distributor for Manhattan and the Bronx.

F. L. Erwin, proprietor of a garage and repair-shop at Cuba City, Wis., is a voluntary bankrupt with liabilities of $6000 and assets of $5000.

C. M. Connolly, 122 East Washington avenue, Madison, Wis., dealer in tires, automotive equipment and supplies, has filed a voluntary petition in bankruptcy, scheduling assets at $1200 and liabilities at $4000.

Guenther-Hayner-Schoblasky Co., Antigo, Wis., dealer in motor cars, tractors and farm operating equipment, has been adjudicated bankrupt on its own application. The liabilities are $29,000 and assets nominally $25,000.

E. R. Harvey has taken on the Anderson line for Hankow, China. Harvey has been located in Hankow, as manager of the Christian and Missionary Alliance for the past nine years. He spent several days at the Anderson factory in Rock Hill, S. C. last week and while there negotiated a contract for representing the Anderson Six.

H. V. Gleasman, Rockford, Ill., agent for the Hupmobile, won $100 prize for setting record sales in the Chicago district during the last quarter. He lead his nearest competitor by four cars. Awards were made at recent three-day meeting of dealers in the Detroit factory office.

The Transport Motor Co., Spokane, Wash., distributor of automobiles and trucks, has entered its new home at Sprague avenue and Madison street.

D. A. Heindel of Youngstown, Ohio, formerly a Dort dealer, has taken on a Dort distributing contract.

Hanson Auto Supply Co., dealing in accessories, is a new St. Paul concern, at 185 West Sixth street. It handles Perfection tires and Katta-Pillar overtires.

O. W. Olson, 231 West Ninth street, St. Paul, has been named Garford truck agent and will open a sales and service station as the Northwestern Garford Co. Mr. Olson formerly was with the St. Paul White Co.

Dale Bros., 1204 East Lake street, Minneapolis 12 years in business, have been appointed authorized dealer by the Pence Automobile Co., Buick wholesaler, and will carry Buick and G. M. C. parts.

John E. Woltzen, Peoria, Ill., has purchased the Roanoke, Ill., garage from Fred J. Darnell, consideration being $20,000. Darnell has been the Ford distributor in that territory for ten years.

Harper-Shourt Mortor Co., 219 Sixth Street S., Minneapolis, has been named by Torbert-McGregor, Inc. as downtown sales agent for the Durant and Star cars. C. W. Harper many years has been head of the Harper garages and has taken as partner A. J. Shourt. A general garage and service business will be conducted.

Hemstreet Bros. of Monticello, N. Y. now handle the Peerless eight.

Warren Given Co., Grand and Milton streets, St. Paul, has been made community distributor for the Buick car. The company handles also the Milburn and Rauch-Lang cars.

Peerless Motor Sales Co., of N. J., with salesrooms and service station at 12 Banta Place, Hackensack, N. J. have taken on the Peerless eight for Bergen County, N. J.

Fogarty and Woodburn of Newburgh, N. Y., have opened salesrooms at 103 Broadway, and will distribute the Peerless eight in that territory.

American Auto Co., Inc. of 68 French street, New Brunswick, N. J. are now Buick and Peerless agents.

Harry A. Goff of Central Valley and Highland Falls, N. Y., has signed up for the distribution of the Peerless in Orange County, N. Y.

James Gibson of Cornwall-on-Hudson, N. Y., represents the Peerless.

Samuel H. Grossman, of Harrison, N. J. former Lincoln distributor for Bergen County, N. J. now has the Peerless.

George W. Nelson, president of the St. Paul White Co., has been appointed to distribute Federal trucks in Minnesota and northwestern Wisconsin. Nelson will continue at 237 West Ninth street. H. E. Casselton is salesmanager. The White line is to be distributed hereafter from the Twin City branch just completed at Twenty-eight and University avenues S. E., Minneapolis.

George J. Krammer and R. H. Deppe have completed one of the largest garages in St. Paul, at University and Farrington avenues, 125 feet square with waiting room, showers and show room 40x60. The firm, to be known as Krammer & Deppe Co., will be a Buick subagency.

Peerless eight is being handled at Monroe, N. Y. by Henry Burgainder.

Einar Lee Motor Car Co., Hupmobile dealer, has removed its service station to larger space at the Ramsey garage, Smith and Ramsey street. The space is 30x120. The sales room will remain at 126 West Sixtn street.

The E. O. Merchant Co., 1012 La Salle avenue, Minneapolis, has been appointed northwestern distributor for Transport trucks.

The Gilbert Motor Co. of Grand Island, Nebr., has secured the agency of the Star car.

Schmidt Motor Car Co., 723 Greenfield avenue, Milwaukee, distributor of the Anderson, has moved its sales and service headquarters to Fourth and Cedar streets, opposite the Milwaukee Auditorium.

Yunker-Hansen Co., West Allis, Wis., established last Spring at 4908 National avenue, has leased the Merry Sales & Service Station, 6516 Greenfield avenue, taking occupancy Oct. 15. The company is Chevrolet dealer.

Jack's Garage, Inc., Milwaukee, is the name of a new $15,000 corporation organized to deal in new and used cars, operate a service station, etc. The principals are John Kotowski, 659 Layton boulevard, Julius H. Komasa and Stanley Kotowski.

Excavation has started for a new garage for the Central Motor Co., 508 North Cherry street, Galesburg, Ill. W. P. Martin, president of the company, commenced business 14 years ago and has steadily increased the volume of business.

Andrews-Beekington Co. has been organized at Belvidere, Ill., and will distribute all kinds of motor vehicles, including motorcycles. A plant will be opened at 115 Logan avenue. Capital stock has been fixed at $150,000.

C. W. Frey Motor Car Co., of Bloomington, Ill., has been incorporated with capital stock of $90,000. The incorporators are C. W. Frey and his two sons, H. O. Frey and J. R. Frey. The company operates a plant at Washington and Madison streets and distributes the Studebaker and Overland cars.

Boulevard garage, 1848 Sixteenth street, Moline, Ill., operated for a number of years by Carl Clausen and William Pearson, has been sold to Albert L. Kuehl of Davenport, Iowa.

Godel-Howland Co. has been organized at Peoria, Ill., and will operate a garage at Franklin street and Fourth avenue and will operate a motor vehicle sales and service agency and handle a line of accessories. Capital stock has been fixed at $50,000.

National Tire Dealers to Meet in Milwaukee Nov. 14

Annual Convention Will Consider Serious Merchandising Problems Confronting the Trade

MILWAUKEE, Wis., Oct. 28—The third annual convention of the National Tire Dealers' Association will be held at the Hotel Pfister, in Milwaukee, on Nov. 14, 15 and 16. Tire retailers from all sections of the country will attend the three-day session to discuss sales policies and merchandising plans for the 1923 season. Many of the problems of the retail branch of the tire industry will come up for consideration.

R. F. Valentine, president of the N. T. D. A., has in charge the preparation of a program that will cover the many topics that have been interesting the tire men in the last year. H. E. Ruhnke, president of the Wisconsin Tire Dealers' Association, which is sponsoring the convention, is co-operating with the tire dealers of the Northwest to make the Milwaukee event a record breaker from the standpoint of attendance.

One of the important features of the convention will be contests to determine the tire changing championship of the country. During the past year several remarkable records for rapid tire changing have been established in various parts of the country, and as a result considerable interest has been developed in this form of competition. While each city boasts of its "fast tire changer," the marks made last August by Charles W. Paine, of Philadelphia, have not been equaled.

At that time, Paine, timed by three watches held by presidents of local automotive trade organizations, mounted a 35x5 casing on a 34x4½ split rim and inflated the tube to 70 pounds pressure in one minute. He also applied a 30x3½ casing with his bare hands in 3 2/5 seconds. Karl Mitz, of Drayton, N. D., came closest to equaling one of Paine's records, when on July 4 he applied a Ford casing in five seconds.

Specialists from all parts of the country are expected to compete with Paine and Mitz at the Milwaukee convention.

HUPP COMPLETES SCHEDULE

DETROIT, Oct. 27—The Hupp Motor Car Co. completed its schedule of 30,000 for 1922 Tuesday, and reports that business will continue on a firm footing. President C. B. Hastings said there were no indications of a severe falling off in business at this time and expressed the belief that it would continue steady through the winter. Increased factory space will permit considerable expansion in 1922, he said. Hastings denied that the Hupp Motor Car Co. was considering the taking over of another car manufacturing company.

CONCERNING MEN YOU KNOW

Clinton B. Amorous, manager of the Locomobile Co. of America's Boston branch, and in charge of its New England distribution, has been made manager of the New York Locomobile branch, 16 West 61st street. Amorous relieves E. A. Travis, general sales manager of the Locomobile company, of the detail of responsibility of the New York branch.

J. C. Agnew, for several years sales manager for Frank H. Sanders, former Chicago dealer for the Franklin Car, has been appointed assistant sales manager of the Detroit Air Cooled Car Co., Detroit.

Charles P. Hughes, formerly secretary of committees of the Automotive Equipment Association, announces that he has become connected with the Frank Miller Co. of Brooklyn, N. Y., as a sales representative in the Chicago territory.

Thomas E. Whitney, formerly manager of the repair department at the Sprague Rubber & Tire factory at Omaha, Nebr., has been promoted to manager of the retail sales and service department of that company.

Chas. H. Simpson, vice president and manager of the Hippodrome Motor Co., Nashville, Tenn., who has been seriously ill for the past seven weeks, is able to be at his office again, but is now taking a country trip driving through in his car to McMinnville and Faulkner Springs, East Tennessee, with his family.

Earl B. Wilson has been appointed director of sales of the Chalmers Motor Co., Detroit, following his resignation from the sales department of the Willys Corp. For several years he was connected with Buick in branch and factory sales work, serving in Chicago, Memphis, Philadelphia and Flint. He entered the sales field first handling farm machinery, serving several years before entering the automobile business.

W. M. Waller, who has represented the Perfection Spring Co., in the replacement sales in the middle west and southwest, died Oct. 22, after an extended illness. Before going with the Perfection Spring Co. he was with the Johnson Bros. Auto Supply Co., of Wichita, Kan., but more recently his home has been in Waco, Tex., where he died.

Howard L. Hamilton has resigned as manager of the Chicago branch of Rolls-Royce of America, Inc.

The Multibestos Co., Walpole, Mass., has announced the appointment as sales manager of E. C. Minor, formerly advertising manager and for the past year assistant sales manager of the company.

B. B. Boyce, service superintendent, and Carl Roberts, parts manager of the Oldsmobile Distributing Corp., distributors for the Oldsmobile for Memphis territory, attended the service and parts managers convention of all Oldsmobile managers at the Lansing Factory of the Olds Motor Works last week.

The Tri-State Motor Sales Co., Maxwell-Chalmers distributor, at Memphis, Tenn., announce the appointment of Opie C. Stephenson as manager of the used car department, located just opposite their salesroom at 413 Monroe avenue.

GAS AND OIL SALES INCREASE

INDIANAPOLIS, Oct. 28—The sale and consumption of gasoline and lubricating oils in Indiana during the first nine months of the year have increased 25 per cent over former figures; and the sale of kerosene during the same period has increased 50 per cent, says William T. Trimble, treasurer of the Western Oil Refining Co. and secretary of the Indiana Independent Petroleum Marketers' Assn. The records are based on figures of distribution of the Western oil concern that operates over the state, and from weekly reports of independent dealers of the state.

R. D. CHAPIN BACK FROM EUROPE

NEW YORK, Oct. 25—Roy D. Chapin, president of the Hudson Motor Car Co., was one of the passengers on the Majestic, returning from a 10 weeks' business trip in France and England. As a result of the trip, Chapin announces the establishment of a general European depot in London for the distribution of Hudson and Essex cars.

"We intend going after European business on a much larger scale than ever before," Chapin announced, "and the establishing of this depot will facilitate business from an exchange and delivery standpoint."

NEW HISPANO CAR

WASHINGTON, Oct. 27—Entirely equipped with American machinery and normally employing about 1,000 men, the Hispano Automobile factory at Guadalajara, Spain, subsidiary of the Hispano-Suiza Co., Barcelona, is manufacturing a new Hispano four-cyclinder eight-horsepower passenger car, the real horsepower of which is estimated to be 20-30, according to a report made to the Department of Commerce by Attache Charles H. Cunningham, Madrid. This car has a maximum speed of 90 kilometers per hour. The factory has orders for 100 of these new cars. Although these cars are constructed in Spain, American electrical equipment undoubtedly will be used in them as in the past.

GOOD ACCESSORY SALES IN INDIANA

INDIANAPOLIS, Oct. 30—Wholesale accessory and equipment trade for Indiana in September seemed to hit record marks, according to several of the large houses of this city. One concern that operates through Indiana and the whole central region says that September was by far the best month of the year, and that October seems bent on beating even the September records. The Indiana business generally is well up to the unusual marks established by other territories covered by this large house. Another concern with business largely centered in Indiana says that September was well in advance as a sales producer and that the record of September, 1921, which was a banner month for last year, was beaten by at least 20 per cent, and that October is holding up to the pace established last month.

FINANCE MERGER APPROVED

NEW YORK, Oct. 30—The proposal whereby the Commercial Credit Co., of Baltimore, was to acquire control of the Continental Guaranty Corp., of New York, has been ratified by the stockholders and the exchange of stock will take place in Baltimore on Oct. 25. While both concerns will retain their identity, after Nov. 1 they will operate under the control of the Baltimore company.

INCREASING TRUCK OUTPUT

SPRINGFIELD, O., Oct. 28—Production is to be increased at the plant of the Kelly-Springfield Motor Truck Co., it is announced. The average lately has been 50 motor trucks a month.

Speedway Manager Goes to Europe to Get Race Entries

T. E. Myers Will Visit Continental Tracks in Behalf of Next Indianapolis Sweepstakes

INDIANAPOLIS, Oct. 28—T. E. Myers, secretary and general manager of the Indianapolis speedway, has sailed for Europe. The Indianapolis Motor Speedway Co. is sending him to Europe to get a line on the prospects for European factory entries in the eleventh annual international 500 mile sweepstakes on May 30, 1923, for 122 cu. in. cars.

On arriving in Europe, Myers will be met by W. F. Bradley, of Paris, who will accompany him on his visits to the European factories. Myers plans to visit factories in England, France, Belgium, Germany, Austria, Italy and also to inspect the famous cement bowl at Brooklands and the new Monza track at Milan. The Indianapolis speedway has decided to accept entries from Germany and Austria for the coming race. Entries also are expected from Fiat, Sunbeam, Ballot, Peugeot and Mercedes.

LEE TO SPEAK IN WEST

WASHINGTON, Oct. 28—American automobile manufacturers, and other business men in the middle west, will be told of the trade extension work that is being conducted by the automotive division of the United States Department of Commerce in behalf of the automobile industry by Gordon Lee, chief of the Automotive Division, who will leave Washington Nov. 1 on a 10-day speaking tour.

His itinerary will be: Nov. 3, an address before the National Association of Automotive Equipment Manufacturers, Chicago; No. 6, an address before the Toledo automobile fraternity and Chamber of Commerce; Nov. 7, automobile men and Chamber of Commerce of Columbus, and on Nov. 10, the Iowa Automotive Trades Association.

FORD CONSIDERS USING RADIO

DETROIT, Oct. 26—Ford Motor Co. is using radio communication on its railroad between Dearborn and Springfield, O., its two main terminals. Consideration is being given to the practicability of using the radio as a means of communication between the plants and branches of the Ford company, this involving the use of a code or the perfection of tuning so there would be no interruption of service.

GOOD SHOW AT AKRON

AKRON, Oct. 27—Akron's first enclosed car exhibit, held Oct. 18 to 21 at the Akron Armory by the Motor Vehicle Assn., has shattered all local records for automobile exhibits despite the fact that it was limited to enclosed models and that there were neither tire nor accessory exhibits. Akron's customary annual automobile show is given each spring.

The READERS' CLEARING HOUSE

Questions & Answers on Dealers' Problems

Copper or Brass Tubing for Gasoline Feed Line

In most instances the gasoline feed line on automotive vehicles is made of copper tubing. Now the question seems to come up as to whether or not copper is the best material from which to make this tubing. The Briscoe Devices Corp. has carried on experiments with copper and brass tubing and has this to say about it:

"In standard makes of carbureters most so-called carbureter troubles, aside from faulty adjustment in adjustable types, are due to dirt in the carbureter or feed line.

Lint Does Little Harm

"In spite of careful screening at the tank outlet, we have often found in the carbureter screen particles of dirt of considerable size. Part of this is lint which passes lengthwise through the screen and afterwards balls up in bunches. This does little harm as a rule.

"The real dirty work is caused by a hard scaly substance in flakes too big to have gotten through the tank screen, and, therefore, evidently formed somewhere between the tank outlet and the carbureter. Actually, they are formed on the inside of the copper tubing, due to chemical action involving the presence of copper, air, water and sulphuric acid. As we cannot change the contents of the fuel, we have therefore tried changing the feed line.

"We have found, after two years' trial by customers, that a brass feed line does not produce this chemical dirt. With a brass feed line, we also find that a good screen at the tank outlet is sufficient, particularly as there is room for an ample screen and trap at this point, and as a carbureter screen must necessarily be small.

"Of course, brass tubing must be annealed to take care of vibration. We recommend using not larger than ¼-in. tubing."

HOW TO LOCATE ENGINE SERIAL NUMBER

Q—Advise by letter where to locate the engine number on 1916-17 Dodge car, also serial number.—Leaf Mountain Garage, Clitherall, Minn.

1—On all models serial number is on toe board right hand side. Also stamped on the center cross member of frame near the right front door. The engine number on the 1915-16 models is on top side of timing gear case at front just ahead of starter generator. On the 1917-18-19 models engine number will be found stamped above the carbureter on the left hand side of cylinder block as well as on the right hand motor leg. Every engine built has the engine number stamped on the right hand leg just about where it enters the frame.

The Readers' Clearing House

THIS department is conducted to assist dealers and maintenance station executives in the solution of their problems.

Readers' names will not be published with articles, if a request to this effect is received with the letter. The name and address should be given, however, so that we can send a copy of our answer direct by letter. This saves waiting for the answer to be published, which sometimes occurs several weeks later, depending upon the space available.

Also state whether a permanent file of MOTOR AGE is kept, for many times inquiries of an identical nature have been made and these are answered by reference to previous issues.

Inquiries not of general interest will be answered by personal letter only. Emergency questions will be replied to by letter or telegram.

Addresses of business firms will not be published in this department but will be supplied by letter.

Technical questions answered by B. M. Ikert, P. L. Dumas and A. H. Packer; Legal, by Wellington Gustin; Paint, by G. King Franklin; Architectural, by Tom Wilder; Tires, by a Practical Tire Man; General Business questions, by MOTOR AGE organization in conference.

RECOMMENDED CARBURETER EQUIPMENT FOR 1914 ALLEN

Q—Publish what style and make carbureter should go on Allen 40, 1914.—Hayden Thomas, Cleveland, Ohio.

The 1914 model 40 Allen carried a 13T model Rayfield carbureter, using a stove No. 300-23, 1¾ in. bore with 24 inches of 1 1/16 in. flexible tubing. The gas line tubing should be cooper 5/16 in diameter. This equipment can be secured in Cleveland from the Hart Ignition Co., or the M. & M. Supply Company.

No Lien for Garagemen in Iowa Statistics

Q—We would like to have a little information in regard to how much right a garage has to collect bills from car owners for labor and parts on a car. Can we make the owner turn over his car to us if he fails to pay his bill 30 days after receiving parts and labor? Do we have to have a warrant from an attorney to do this? Any information in this line will be greatly appreciated.—Frahm Witt Garage, Manning, Iowa.

It appears that Iowa does not have a statute giving the garagekeeper a lien for repairs. Therefore, he must depend on the ancient common law lien, which permits him to retain possession of a repaired article until his charges for repairs are satisfied.

If you have delivered the car to the owner your only recourse is to sue and obtain a judgment for your charges. Then if debtor will not settle for the judgment you may seize the car under the judgment. Of course, you cannot make the car owner turn over the car after 30 days for failure to pay the bill for parts and labor, nor can an attorney give you such a warrant. You will have to collect as on any other open account against a debtor.

BUICK VALVE CAGES REMOVED BY EXPLOSION PRESSURE

In a recent issue of MOTOR AGE a method was given of removing Buick valve cages by means of a crowbar. One of our subscribers, however, has written in and given a method which he claims is much superior. This is to loosen the retaining rings one or two turns and then start the engine and the explosion pressure has the effect of forcing the cages loose.

It is stated that there is no danger at all in this method, for as soon as a cage loosens up it automatically relieves the pressure and prevents further firing of that cylinder. It is further claimed that this method never fails and never results in bent or broken parts. This information was submitted by Deming Brothers' Garage at Chaplin, Conn., and we take this opportunity of expressing our appreciation for the interest shown in sending in this helpful suggestion.

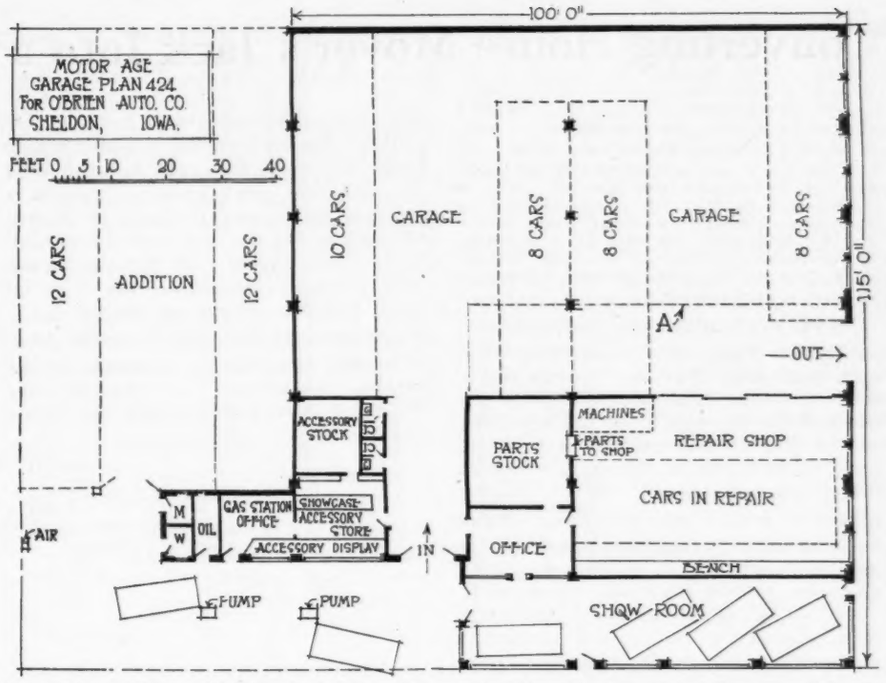
THIS READER ASKED TO REFER TO PAST ISSUE

Q—Print instructions on charging Ford magneto using four six-volt storage batteries as appeared in MOTOR AGE some time ago.—A Reader.

Instructions for charging Ford magneto are in the August 3, 1922, issue of MOTOR AGE and we would advise that you refer to that number.

Large Sales, Service and Garage With Filling Station

I would like to get some plans and suggestions for building a garage. I am selling cars and have a large territory and so want space to display about four cars. Would also like to store about 35 cars. Wish to have a repair shop for about four men and want space for a good oil and gas business (possibly a separate station). I anticipate a very good accessory business as this lot is on the main highway in a city of 4,000 inhabitants. We have plenty of room as the lot is 165 by 150 ft., but, of course, do not intend to take up the entire space. We wish to thank you for any service you may render.—Arthur Roggen, Sheldon, Iowa.



We have used considerable more space than indicated on your sketch, but it has been necessary in order to fulfill your conditions. The garage will hold 34 cars and the shop will hold five or six cars which is about all four men could work on. The show room is not of the best proportion, but has a good extensive frontage for display and will hold four cars nicely.

If the shop and show room seem inadequate we suggest that they be enlarged by taking in the space as far as A or even double that amount. When the storage branch develops so that you need more space the 50 ft. addition can be made which will about double the space. The filling station is to all intents a separate institution, or it may be operated in connection with the accessory store if desired.

There is still a 50 ft. strip at the back of the lot and this can be built upon by extending the present units or making a new transverse unit facing on the side street. The sales and service section may be locked up at night and the garage kept open. The same is true of the accessory store. In fact, all the branches are quite independent of one another.

Architectural Service

IN giving architectural advice, MOTOR AGE aims to assist its readers in their problems of planning, building and equipping, maintenance stations, garages, dealers' establishments, shops, filling stations, and, in fact, any building necessary to automotive activity.

When making request for assistance, please see that we have all the data necessary to an intelligent handling of the job. Among other things, we need such information as follows:

Rough pencil sketch showing size and shape of plot and its relation to streets and alleys.

What departments are to be operated and how large it is expected they will be.

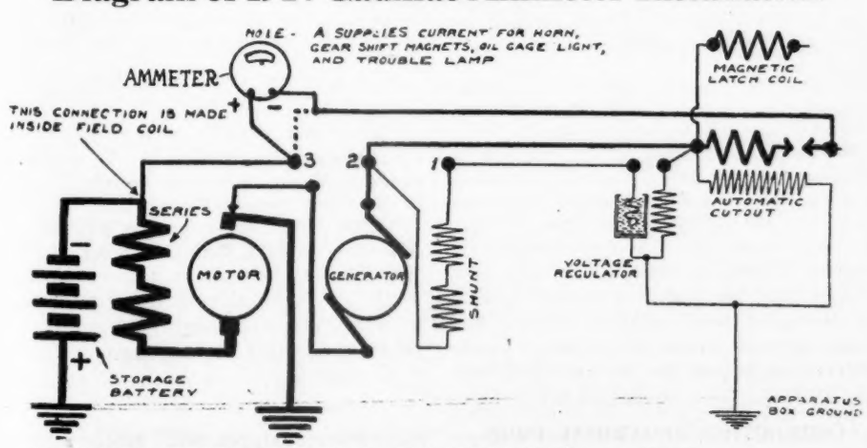
Number of cars on the sales floor.

Number of cars it is expected to garage.

Number of men employed in repair shop.

How much of an accessory department is anticipated.

Diagram of 1914 Cadillac Ammeter Installation



AMMETER INSTALLATION ON 1914 CADILLAC #100799

Q—We cannot find the issue of MOTOR AGE in which diagram was given for installing an ammeter on a 1914 Cadillac, and we would like to have a rough sketch showing how this is accomplished.—The Lee County Motor Repair Co., Fort Myers, Fla.

As it is some time since this diagram was shown in MOTOR AGE we are publishing it again. By referring to this it will be seen that the wire from the number three terminal of the motor generator is disconnected and fastened to one of the ammeter terminals. Another short wire is then connected from the other ammeter terminal to the number three motor generator terminal.

INSUFFICIENT DATA ON THIS CASE

Q—I have a problem which I would like your Readers' Clearing House to help solve. It is as follows: A Chevrolet 1920-Model 490 carbons up so that it requires cleaning about every 200 miles. The engine was thoroughly overhauled and leak-proof piston rings fitted. The engine is not in need of reboring. Best grades of oil used and has been checked over by a competent mechanic without locating any serious trouble.—The Schurman Garage, Summerside, P. E. Island.

1—In the face of your statement that the engine has been thoroughly overhauled, we can see no reason for this excessive carbonization except a very poor fit of the piston or rings and would advise that you remove the piston and rings and examine them. During the time the pistons are removed, it would be best to micrometer each cylinder at several points along the travel of the pistons. It is difficult to imagine a condition where an engine requires cleaning every 200 miles and still find upon checking that every item is O. K. From the information given, we are unable to submit any further diagnosis and would request that you supply further information. There are no special characteristics of this model and it is not addicted to chronic oil pumping or carbonization.

Converting House Mover's Jack Into a Simple Arbor Press

Q—I am enclosing a crude drawing of a ten ton house mover's jack which we wish to convert into a garage press to be used largely for pressing differential gears on and off Ford axle shafts. We have a Studebaker Special Six frame that is in good shape except the front frame horns and we intend to use this for the frame of our homemade press. Any suggestions or a drawing that would help us would be highly appreciated.

1—The drawing shown gives a general outline of what could be accomplished with equipment that can be very easily secured. Beginning at the top of the press the arch support for the mounting of the jack is constructed of ⅜ or ½ inch channel iron of the same width as the Studebaker siderails. This is riveted, folded or welded into the frame at the position of the cross member which is left intact. This arch support should be epuipped with a plate as shown at B.

This plate should be constructed of ½ inch material and is either riveted or bolted to the cross member and arch support as shown. The bottom or foot of this plate should be flushed with the bottom of cross members. In order to make the presses applicable to work of different lengths it is advisable to have a movable member. In this sketch the movable member is the lower member and its adjustment is secured by means of filing notches in the side of the Studebaker siderails.

These notches should be of sufficient width to accommodate a 1 inch bolt and have approximately ⅛ of an inch play sideways. They should be about 1¼ inches in depth and should be located at an angle of about 20 to 25 degrees from the vertical in relation to the Studebaker siderails. The movable member should be constructed of 3 to ½ inch channel steel of 5 or 6 inches width. A guide plate made of 5/16 or ⅜ in. angle iron should be riveted or bolted at each end of each of the movable members in order to resist the tendency of the Studebaker side members to spring inward.

The feet for the press are formed of pieces of angle iron which should be about two ft. long with not less than a 2 inch flange or web. Two lengths of pipe of the correct length should be placed between the legs and through them should be placed a rod with a nut at each end. This will enable the base or legs to take both compression and tension. We believe that the remaining details are self explanatory and reference to the sketch will be sufficient guide to permit construction. No attempt is made to give exact dimensions as these will vary with the equipment on hand and the service to which the press is to be put.

2—How can the front universal joint of a 1920 Nash Six be greased? I can see the grease plug but it is so far inside the drive shaft brake drum that it cannot be removed.

2—The front universal joint on a 1920 Nash Six can be greased by loosening the nut on the front universal housing that controls the coil spring retainer which holds the universal joint housing over the universal joint proper. This is a stamped nut and can easily be turned off. After the nut has been backed off of the last thread, the spring tension will have been released and the universal joint housing should be drawn backwards towards the rear universal joint. This will permit the housing to be packed with grease and forced up over the joints proper after which the spring can be moved forward and tightened by means of the nut which was previously removed.

3—How can the inside bottom nut on the starter of a model A Essex be removed without using a cold chisel?

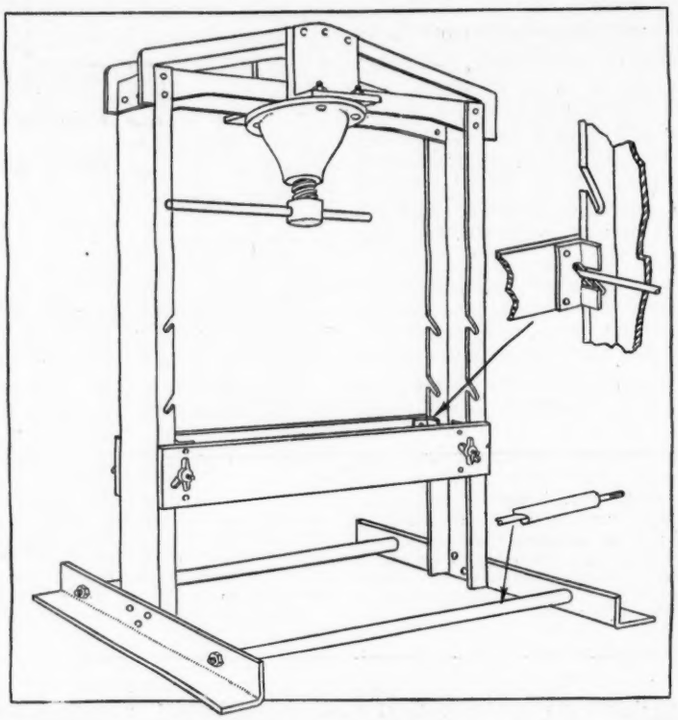
3—The nut referred to is removed in Hudson-Essex service stations by using a high grade end wrench which is placed over the nut in much the same manner as you would use a socket wrench. A second wrench of any style is then used placed over the first or a double wrench arrangement as it might be called. Another method would be to file a screw driver slot across the nut and then construct a special screw driver which would be recessed in order to accommodate the bolt which would obstruct the slot on each side of the nut. First method, however, is comparatively simple and is used with success in the authorized Essex service establishment.

4—In testing Ford coils with a direct current at 6 volts pressure how many amperes should they draw?

4—If the Ford coil units are in good shape the draw of amperage will be from 1¼ to 1½ amperes.

5—As a general rule should king pin bolts slant to the rear at the top and if so why?—Texas Steam Vulc. Co., Temple, Texas.

5—A king pin bolt is sometimes slanted to the rear in order to give a caster effect to the front wheels which assists in maintaining the wheels in the straight ahead position or in other words, assists in steering, especially at high speeds. Without going into a lengthy description it might be said that the effect of setting the king bolts at an angle is similar to the effect of placing the front wheel of a bicycle considerably ahead of its point of pivoting on the head or frame of the bicycle.



CORRECTION REGARDING FORD HORN

In the September 21st issue of MOTOR AGE, on page 42, we stated that all Ford cars were equipped with alternating current horns. This is no longer correct and has been called to our attention by two or three subscribers whose interest we very much appreciate. According to the Ford factory branch at Chicago, the change, however, is of rather recent date.

According to them, all closed models have been equipped with direct current horns operating from the battery since approximately August 15th, while all other cars equipped with starting and lighting have had the direct current horns since approximately September 23rd. On those cars where starting and lighting systems are not ordered, it is of course still necessary to use the alternating current horn, as no battery is available.

183 Inch Duesenbergs Are Straight Eights

Q—Were all Duesenbergs straight eights, in the last Indianapolis race on Decoration day?

1—All Duesenbergs that were entered at the Indianapolis 500-mile race on Decoration day were of the eight cylinder tandem or in line type.

2—What advantage has the straight over the V type engines?

2—One particular advantage over the V type is that the straight eight construction allows for the building of a very narrow engine, allowing a better stream line body. It is also claimed, by the adherents of the straight eight, that better lubrication and better balance is secured, although both of these statements are open to question. The "V" eight makes use of a shorter crankshaft. The straight eight has some theoretical advantages over the "V" eight and with the same reasoning it can be said also that the "V" eight also has some theoretical advantages over the straight eight. The sum of all these advantages and disadvantages could be best learned by the performance of the engine in actual service.

3—Is there very much wear on the "V" type of cylinders?

3—This is entirely a controversial question and cannot be answered definitely. Theoretically, there should be slightly more wear on the under side of the pistons and cylinders on a "V" engine due to the angle of the cylinder blocks, however this cannot be substantiated in actual practice because many successful "V" type eight cylinder engines have operated over long periods of time without the necessity of regrinding. As before stated these questions can be answered only from a theoretical standpoint and any conclusions arrived at theoretically may not hold true when that theory is put into practical use.

4—What is the h.p. of the straight eight?

4—The maximum h.p. obtained from one of the Duesenberg straight eight racing engines was 114 h.p. at 4250 r.p.m. This is with the racing engine under favorable conditions and should not be taken as the power developed by the stock straight eight as employed in the present car chassis.

5—How many carbureters does it have? —Louis G. A. Greiner, Rock Island, Ill.

5—Two Miller carbureters were used on the Duesenberg straight eight racing car at Indianapolis.

WHAT CORRODES THE POSITIVE BATTERY TERMINAL

Q—Why does the positive terminal of a storage battery always corrode faster than the negative, even though there is no acid leaking near it? Of course, when charging, a vapor will come from the vent holes, but what is the chemical reason that it attacks the positive more than the negative connections. We wrote to another publication, but their answer ignored our desire to know "why" and loftily replied, "It is the acid, of course, that does the corroding."

1—We do not entirely blame the publication referred to for failing to give a logical answer, as there is very little understood on this subject. Taking the matter up with the chemical engineer of one of the large battery concerns, we obtained a possible explanation in the fact that the acid when decomposed liberates oxygen at the positive post and hydrogen at the negative post.

Now, assuming that there is a very slight leak around the post, we can easily see that the oxygen liberated at the positive post will facilitate any chemical action which has a slight tendency to take place, as nascent or newly liberated oxygen is very active chemically. Under the assumption that there is no leakage around the post, we will have to fall back on another theory.

It is recognized that it is dangerous as far as clothes are concerned to carry a battery without holding it at arm's length, even if the battery appears to be dry. We will therefore have to assume that even on a storage battery, where the surface appears to be dry, that there is in reality a very slight film of acid, which has a tendency to creep up over the entire surface. Under these circumstances, when the battery is on charge we can figure that there is, in addition to the chemical action inside the cell, a similar action on a small scale taking place in this film of acid on the top cover and that minute quantities of oxygen are thereby liberated in the vicinity of the positive terminal.

We admit that this is rather a far-fetched explanation, but we would like to receive a better one. It is also possible that a post may be sealed against flow of acid and still provide a leakage path for oxygen which has been liberated from the electrolite. In other words, the pitch may be somewhat porous as far as gas is concerned.

2—We have been attempting to obtain a softer battery sealing compound than is commonly used, in order to avoid having it crack in cold weather. One publication gave us the helpful information that we could get softer pitch by heating. The idea of adding cylinder oil to the melted pitch was tried, a Ford hub cap full of cylinder oil being used to a quart of melted pitch, and the results were fairly satisfactory.—Fleck & Buchholz, Hinsdale, Ill.

2—Battery compound as supplied by jobbers is ordinarily rated in three grades, hard, medium and soft, although a more technical rating takes into consideration the flow or melting point and also the penetration. The penetration is determined by taking the time that a needle requires to sink 1 centimeter into the pitch at a certain temperature when a definite weight is used on top of the needle, but we do not have available the exact conditions under which such a test is made. It would accordingly be well to find out exactly the type of pitch that has been obtained. For example, if medium compound has been supplied by the jobber, then it would be well to request soft compound the next time an order is placed.

BOSCH NU-4 MAGNETO DEAD ON ONE SEGMENT

Q—We have a Bosch NU-4 magneto which will not fire on the inside segment. We cannot find anything wrong. This is the second one to go bad on the same segment. Have you anything that you can suggest as to cause of this condition? —F. D. Bowyer, care North Garage, Walton, Ind.

1—The Bosch NU-4 magneto was never much of a success, there being several reasons for this. In the design of this magneto it has to fire two gaps in series, one in the cylinder which is firing and the other gap in one of the other cylinders, and this naturally puts a somewhat heavier strain on the secondary inulation than would otherwise be the case. Then if a wire should be off of a spark plug there is an enormous voltage strain on the insulation and no safety gap is provided to take care of such a condition.

Using spark plugs without frequently checking to see that the gaps are properly set will also strain the secondary insulation. In winding the armature the primary or heavy winding is put on first and the secondary is wound on top of it, but both ends of this secondary are supposed to be insulated. It is comparatively easy to insulate the outer end, but the inner end, which is right next to the primary, is a more difficult proposition and the breakdown at the same segment is probably due to the spark jumping through to the primary or frame of the armature.

There is no remedy for this particular armature except to have it rewound, but when you have it again installed, would suggest your setting the spark plug gaps to .020 inch, or in other words the smallest gap you can use and still get satisfactory action from the engine. Then if you will watch the spark plug gaps and see that they do not burn away so as to put a heavy strain on the armature, we believe that you will have a satisfactory operation.

TEST DOES NOT MEAN ANYTHING

Q—We have an electrical problem we would like solved. We have tested a Kingston magneto by connecting two dry cells in series and connecting one end of this pair of cells to the end of the primary which extends from the magneto. Then when we connect the other end of the pair of dry cells to the frame of the magneto we get a spark. Explain why this occurs.—Tremont Implement Co., Tremont, Ill.

1—From the live terminal of a Kingston magneto there are three paths through the magneto to the frame. One across the interrupter points, which circuit, of course, is broken when the points are opened. Another path is through the winding of the armature to the other end of the winding, which is grounded. The third path is through the primary winding of the coil, which is mounted in the dome of the magneto. This, accordingly, accounts for your getting a circuit from the terminal to the frame of the magneto, and such a test does not mean anything as far as determining whether the magneto is in good condition or not, and if this magneto is giving trouble it should be sent to some reliable electrical service station.

CADILLAC PISTON CLEARANCE

Q—Supply information on following as soon as possible. We have a type 55 Cadillac engine to overhaul and would like to know what clearance piston should have and what clearance to use if new pistons are required. This engine is using a lot of oil, and would also like to know what rings to use and what clearance they are to have.

The recommended clearance on the Cadillas piston is .002 at the skirt, with the usual amount of relief at the ring lands, which in this case should be .008 at the top land and about .006 at the second land. Practically any of the standard makes of piston rings will give satisfaction in the Cadillac, although the local Cadillac service station recommends the use of either the Gill or the Eagle ring. There will be no necessity of a patented oil ring if the cylinders are truly circular and if the pistons have the proper amount of diametral clearance.

2—Would also like to know the best way of fitting bearings, to put new bearings in engine or use old bearings, as I have heard there are no shims in these bearings.—Raymond Reinhardt, care Mascoutah Garage, Mascoutah, Ill.

2—The connecting rods to which the pistons in the left-hand block of cylinders are attached are forked at their lower end. Bronze-back babbitt-lined bushings clamped in these rods have their bearings on the crankshaft. The connecting rods to which the pistons in the right-hand block of cylinders are attached are straight and have their bearings on the outer surface of the bushing clamped in the forked rod.

Bearings at the lower end of the straight connecting rods are adjustable. Liners varying in thickness from .002 to .006 inch are placed between the caps and the rods when the engine is assembled. To readjust, remove these liners and substitute thinner ones of the proper thickness. To secure best results, these bearings should have from .002 to .003 play.

Do not, under any condition, adjust these bearings closer than .002, as this amount of clearance is necessary to allow for the greater expansion of the bronze-back bushing than the steel connecting rods when the engine is heated.

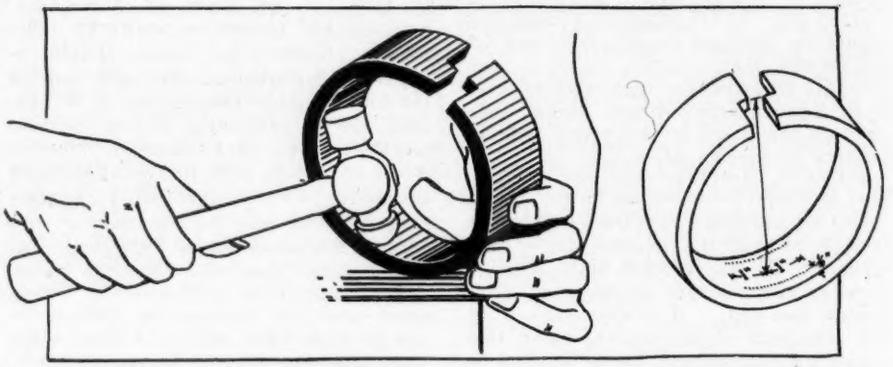
The bronze-back bushings in the forked connecting rods are not adjustable. If, as a result of long use or improper lubrication, these bushings have too much play on the crankshaft, they should be replaced by new ones.

There are three main crankshaft bearings, these bearings are provided with liners which are clamped between the crankcase and bearing caps. To tighten main bearings, proceed as follows: Remove the oil feed pipes connecting the bearing caps with the oil manifold. Remove the aluminum bearing caps with the lower half of the bearing and the liners. Replace the liners with liners which are less in thickness by an amount equal to the amount of takeup necessary. Liners can be obtained varying in thickness by .001 of an inch, each liner is stamped indicating its thickness.

Carefully reduce the upper edges of the lower half of the bearing just enough to allow the aluminum bearing cap to clamp the new liner. This work must be done very accurately, as clearance between the halves of the bearings will cause an oil leak which may prove disastrous to the bearings. Thoroughly clean the bearings, bearing cap and liners and oil the bearings surface before replacing.

In replacing the bearing cap, tighten the bearing nut firmly and lock with cotter pins. Also make sure that the packing nuts in the oil pipe are tightened sufficiently to prevent leakage. The upper edges of the lower half of the bearing may be reduced, if necessary, by rubbing the bearing on a piece of fine emery cloth stretched tightly over a flat machined iron surface.

Fitting the Junk Ring



Q—Have a Willys-Knight 88-4 B T No. 16542 car that has been driven 13,000 miles. New rings were installed after it had covered 11,000 miles and these rings apparently haven't helped the engine. The compression is poor and it smokes badly through the exhaust and the plugs get oily. Could this trouble be caused by a poorly fitted junk ring?

1—A poorly fitted junk ring will cause a lack of compression in the same manner as a leaking cylinder head gasket would. A leaking junk ring usually can be detected by hearing the escape of air past the junk ring when the piston is brought up on the compression stroke.

2—The mechanic who put the rings in said that the sleeves were in A-1 condition. Would you recommend using the double seal or the oil regulation type piston rings in this engine?

2—The recommended piston ring for this engine is the Gill. Generally speaking, the best ring to use in any particular engine is the ring that is used as regular equipment by the manufacturer of that engine.

3—Would be glad if you would give information as to how to fit the junk ring and size of piston ring for this engine.—W. J. Felts, Modern Tire Shop, Coffeeville, Kans,

3—Remove the cylinder head, then remove the junk ring from the cylinder head using the junk ring spreading tool that can be secured from a Willys-Knight service station known as tool SD 209. Clean all carbon from the seat and cylinder head. If ring is too wide to fit groove it must be lapped to a perfect fit. The end clearance is taken care of in the manufacture of the junk ring and no attention need be given to this point except to check up and see that the ends do not actually touch each other when the ring is compressed in sleeve.

On some old engines the junk ring may give rise to a very decided noise known as a junk ring click which occurs at camshaft speed. This noise is caused by looseness or side play of the junk ring in its groove in the cylinder head, this looseness allowing the ring to move up and down which accounts for the very noticeable noise produced by a loose junk ring.

If the junk ring is not in need of replacement due to the fact that it is making contact at all points on the sleeve, the junk ring noise can be removed by peening.

A diagram showing the peening process and the points where the peening should be done is shown in Fig. —. It should be remembered that the peening should be done only at certain points on the inside periphery of the ring. The extent of the peening should extend for 1 inch on either side of a point directly opposite the ring slots and peening should not be done closer than ⅛ of an inch from either edge of the ring. The piston ring size for the 88-4 Willys-Knight is 4⅛ by ⅜ in. regular. The junk ring must be a free fit in the ring groove. The clearance to be allowed on the double seal ring is .005 to .0065.—W. J. Felts, care of Modern Tire Shop, Coffeeville, Kans.

PERHAPS THE WOOD IS DEFECTIVE

Q—We wish to suggest a possible solution for the trouble recorded by the Reily Garage in the August 24 issue of MOTOR AGE, where they had occasional missing on a Ford car. We have had a Ford perform in the same manner and have found that inside the coil box the small wires would be loose or broken and have corrected this trouble by installing a new coil box.—A Reader.

MOTOR AGE has the suggestion to make that as long as the box is otherwise satisfactory it might pay to replace the broken wires or to resolder them. We appreciate however that, in some cases, Ford parts can be bought for less than the cost of labor for repairing so that the question of repair or replacement would have to be decided depending on the immediate circumstances.

History of the Hotchkiss Drive

Q—Enlighten us on the history of the Hitchkiss drive. We have been informed that Hotchkiss who invented the particular type of drive used in many automobiles was not an American manufacturer and that the car he is now building in Europe does not have the Hotchkiss drive, he having discarded this particular type of drive in preference to a drive with distance rods and torque member, similar to construction used on Locomobile.—R. C. Douglas, San Francisco, Cal.

The first automobile to be built without radius rods or torque members came out of the Hotchkiss factory at St. Denis near Paris in 1904 and was exhibited at the Paris automobile salon of the same year. In 1875 Benjamin B. Hotchkiss, an American citizen, went to France and established the Hotchkiss gun factory. It was not until 1903 that this company built an automobile, the design of which was in the hands of engineer George Terrasse who had received his technical education in the French schools, and his practical automobile experience at the Mors factory.

As a Mors engineer, Terrasse was naturally influenced by practice in those shops. At that time there were two distinct schools interested respectively in chain and shaft drive. Although Mors was a strong supporter of the chain drive, the first car built by Terrasse for the Hotchkiss was designed with shaft drive. This car had a four cylinder engine of 105 by 120 millimeters bore and stroke and was very much criticized at that time by reason of the high power it was proposed to transmit by means of cardan shaft. At that time, Renault was the leading maker of shaft drive cars but he did not dare attempt to use an engine of anything like the same size and power as the Hotchkiss was putting in his cars.

Rear Suspension Was Platform Type

The first car to be built by Hotchkiss, while having radius rods, did not have any torque member. The rear suspension was platform type. In 1904 a car was built and put on exhibition at the Paris show with the system now known as the Hotchkiss drive, which was an improvement over the original job. No radius rods were used. The cars were in production for 1905 and have not changed so far as this feature of the design is concerned since that year.

Engineer Terrasse was convinced that the springs could be made to fulfill the three functions of suspension, propulsion and reaction. This car which had a wheelbase of 116 inches was fitted with springs having the unusual length (for that period) of 51 inches and a width of 2 inches. This was also the spring width of the previous years' cars with platform springs and radius rods. There was immediately discovered that the suspension was unsatisfactory and after a few cars had been turned out with this width of spring the number of leaves was decreased and the width increased to 2½ inches. This was an exceptionally wide spring for that period being very greatly in excess of the width adopted by any other maker.

George Terrasse was the first to discover that satisfactory results with the Hotchkiss drive and good suspension could only be obtained with very long broad springs having a small camber. At that period, springs were short and narrow and had a comparatively large number of leaves. It was not until later that the advantage was perceived of making the springs as thin as possible and increasing the number of leaves.

It was predicted that there would be universal joint trouble and spring breakage with the Hotchkiss drive. None of these troubles materialized and after the first increase in the width of the springs the system remained entirely unchanged on the Hotchkiss cars from its adoption in 1905 to the present date.

Other Firms Cheapen Drive

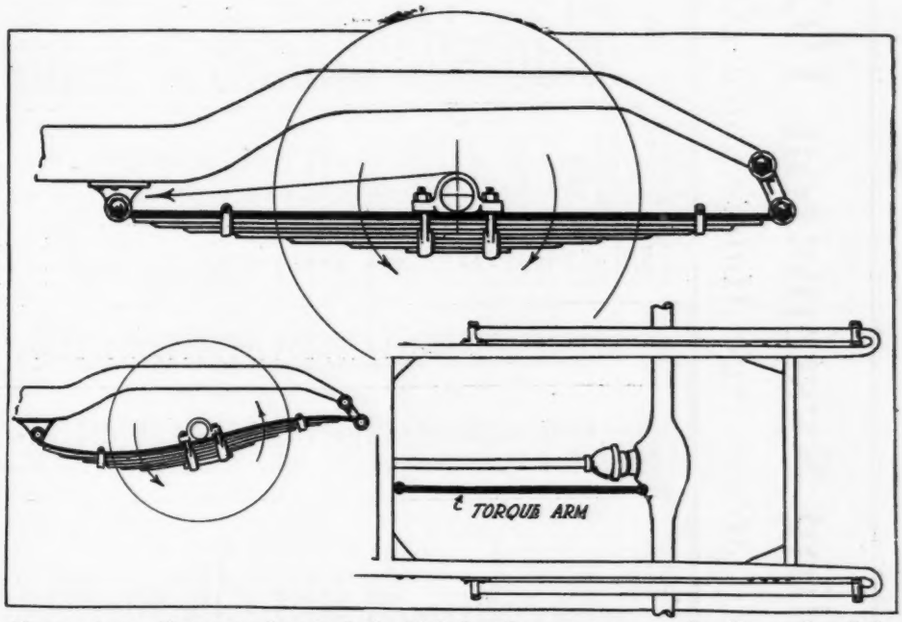
Sometime after Hotchkiss began to use his drive, other automobile spring firms adopted it with the sole object of cheapening the construction. They had no thorough knowledge of the subject and tended to bring discredit on what is now recognized to be a most valuable system. Faults were prevalent on Hotchkiss drive cars which were unknown on the original Hotchkiss car. It has to be admitted that this system of design, which is now appreciated at its full value, attracted comparatively little attention in 1904. At that time engineers were discussing whether cars should be driven by shaft or by chain.

It is interesting to note that neither in France nor in England is the designation of Hotchkiss drive known to the motoring public. In the latter country the term "spring drive" is used although this does not by any means cover the invention of George Terrasse as first applied to Hotchkiss cars. In France the Hotchkiss drive is rather laborously referred to as "drive and reaction by means of the springs." From all the data that can be gathered the Hotchkiss drive which does not make use of radius rods is employed on the Hotchkiss car as manufactured today.

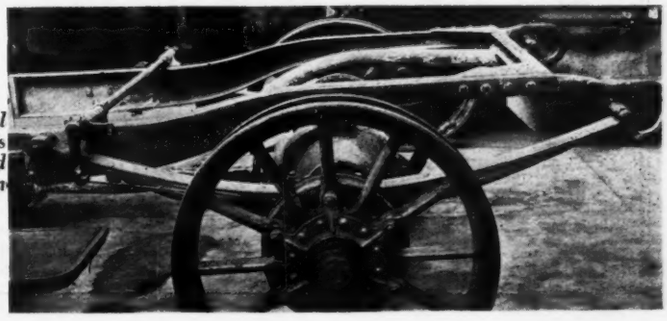
MAKERS OF ELCAR UNITS

Q—What make of transmission, universal joint and rear axle was used on the 1918 model Elcar?—E. M. Rogers, Carroll, Iowa.

You do not state whether the 1918 Elcar is a four or six-cylinder model; however, the Mechanics gearset was used on the four-cylinder model and the Muncie gearset on the six-cylinder model Both the four and six used Salisbury axles as well as Mechanics universal joints.



Upper view: Exaggerated main leaf which functions as torque and radius rod. Left: Turning tendency of axle housing, counteracted by rigidity of spring. Right: Widely used modification of the original Hotchkiss drive. A separate, flexibly mounted rod which counteracts the torque reaction



Suspension of original Hotchkiss car. In this design, the torque and driving effort are taken by the rear spring

Cooling Systems on 1922 Passenger Cars

Motor Age Maintenance Data Sheet No. 187

MAKE AND MODEL	Type of Core	Make of Radiator	Capacity of Complete Cooling Sys.	Water Circulation	Type of Pump	Temperature Controlled By
Ambassador, R		Drake	5½ gals.	Pump	Gear	Thermostat
American, C		Livingston	6 gals.	Pump	Cent.	
Anderson, 40	Ribbon Cel.	Fedders	4¾ gals.	Pump	Cent.	
Appersen, 8	Fin. Tube	Own	9 gals.	Th-Sy.		
Auburn, 6-51	Ribbon Cel.	Jamestown	4½ gals.	Pump	Gear	
Bay State, 1	Ribbon Cel.	G. & O.		Pump	Cent.	Thermostat
Biddle, B1	Ribbon Cel.	G. & O.		Th-Sy.	Cent.	
Brewster, 62	Tubular	English Mersick	7 gals.	Pump	Cent.	
Buick, Six	Ribbon Cel.	Own	5⅓ gals.	Pump	Cent.	
Buick, Four	Ribbon Cel.	Own	3¼ gals.	Pump	Cent.	
Cadillac, 61	Fin. Tube	Own	6 gals.	Pump	Cent.	Thermostat
Case, X	Fin. Tube	Own	4 gals.	Pump	Cent.	Thermostat
Case, W	Fin. Tube	Own	4½ gals.	Pump	Cent.	Thermostat
Chalmers, 35c	Ribbon Cel.	McCord		Th-Sy.	Gear	
Chandler, 1922	Ribbon Cel.	Commercial	4 gals.	Pump	Cent.	
Chevrolet, 490	Ribbon Cel.	Harrison	1¾ gals.	Pump	Cent.	
Chevrolet, FB			3 gals.			
Cleveland, 41	Ribbon Cel.	Harrison	3 gals.	Pump	Cent.	
Cole, 890	Ribbon Cel.	McCord	5¾ gals.	Pump	Vane	Thermostat
Columbia Six	Ribbon Cel.	Harrison	2 gals.	Pump	Vane	Thermostat
Columbia, Challenger	Fin. Tube	Harrison	4½ gals.	Pump	Vane	
Columbia, Light 6	Ribbon Cel.	Harrison	1½ gals.	Pump	Vane	
Crawford			6 gals.			
Cunningham, V	Ribbon Cel.	G. & O.	10 gals.	Pump	Cent.	Thermostat
Daniels, D19	Ribbon Cel.	G. & O.	10¼ gals.	Pump	Vane	
Davis, 71		Jamestown	3 gals.	Pump	Cent.	
Davis, 61-67		Jamestown	3 gals.	Pump	Cent.	
Dixie Flyer, H	Ribbon Cel.	Candler	3½ gals.	Th-Sy.		
Dodge Bros	Fin. Tube	McCord	2¾ gals.	Pump	Cent.	
Dorris, 6-80	Ribbon Cel.	Modine	4¼ gals.	Pump	Cent.	
Dort, 19	Ribbon Cel.	Fedders	5¼ gals.	Th-Sy.		
Driggs, 1922	Ribbon Cel.	Mayo		Th-Sy.		
Duesenberg	True Cel.	Own	8 gals.	Pump	Cent.	
Durant, A-22	Ribbon Cel.	Fedders	3¾ gals.	Pump	Cent.	
Durant, B-22	Ribbon Cel.	Fedders	3½ gals.	Pump	Cent.	
Earl, 40	Ribbon Cel.	Sp-With.	5 gals.	Th-Sy.		
Elcar, K-4		Jamestown	5 gals.	Th-Sy.		
Elcar, 7-R		Jamestown	4½ gals.	Pump		
Elgin, K-1	Ribbon Cel	Standard	4 gals.	Th-Sy		
Essex	Fin. Tube	Harrison	6 gals.	Th-Sy.		Shutter
Ford, T	Fin. Tube	Own	3¼ gals.	Th-Sy.		
Franklin, 9B	None	None		None	None	
Gardner	Ribbon Cel.	Fedders	5 gals.	Th-Sy.		
Grant	Fin. Tube	Long	4¼ gals.	Th-Sy.		
Gray	Ribbon Cel.	Corcoran		Th-Sy.		
H. C. S., Series 3	Ribbon Cel.			Pump	Cent.	
Handley-Knight, B	Ribbon Cel.	Harrison	5 gals.	Th-Sy.		
Hanson, 60	Fin. Tube	Long	5 gals.	Pump	Cent.	
Hatfield, A-42		Jamestown	5 gals.	Th-Sy.		
Haynes, 55	Ribbon Cel.	Fedders	7 gals.	Pump	Cent.	
Haynes, 75	Ribbon Cel.	Fedders	7 gals.	Pump	Cent.	
Holmes, Series 4	None	None				
Hudson, Super 6	Ribbon Cel.	Harrison	4¼ gals.	Pump	Vane	Shutter
Hupmobile, R	Ribbon Cel.	McCord	5½ gals.	Th-Sy.		
Jackson, 638	Fin. Tube	Long	4½ gals.	Pump	Cent.	
Jewett, Six	Ribbon Cel.	National	3¾ gals.	Pump	Cent.	
Jordan, MX	Ribbon Cel.	Sp-With.	4¼ gals.	Pump	Cent.	
King, K	Ribbon Cel.	Fedders	9 gals.	Th-Sy		
Kissel	Ribbon Cel.	Sp-With.	6¾ gals.	Pump	Vane	Thermostat
Kline, 6-55	Ribbon Cel.	Fedders	5½ gals.	Pump	Cent.	
LaFayette, 134		Harrison	6 gals.	Pump	Cent.	Thermostat
Lexington		Fedders	4½ gals.	Pump	Cent.	Thermostat
Liberty, 10-D		American	6½ gals.	Th-Sy.	Gear	
Lincoln	Fin. Tube		7½ gals.	Pump	Vane	Shutter
Locomobile, 48	Ribbon Cel.	G. & O.	10 gals.	Pump	Vane	Thermostat
McFarlan, TV		Ansted	7½ gals.	Pump	Cent.	
Maibohm, B		Standard	3¼ gals.	Th-Sy.		
Marmon, 34	Ribbon Cel.	McCord	5½ gals.	Pump	Cent.	
Maxwell		Own	3¼ gals.	Th-Sy.		
Mercer, Series 5	Ribbon Cel.	McCord	7 gals.	Pump	Cent.	
Merit		G. & O.	4½ gals.	Pump	Cent.	
Mitchell, F-50		Modine	6 gals.	Pump	Vane	Thermostat
Monroe	Ribbon Cel.	Fedders	3½ gals.	Th-Sy.		
Moon, 6-40	Ribbon Cel.	Fedders	4½ gals.	Pump	Cent.	
Moon, 6-48	Ribbon Cel.	Fedders	5 gals.	Pump	Cent.	
Nash, 4	Fin. Tube	Long	3¾ gals.	Pump	Vane	
Nash, 6	Fin. Tube	Long		Pump	Cent.	
National, BB	Ribbon Cel.	Fedders	7 gals.	Pump	Cent.	
Noma, 1D	Ribbon Cel.	Own		Pump	Cent.	
Noma, 3C	Ribbon Cel.		4¾ gals.	Pump	Cent.	
Norwalk, 430-KS	Ribbon Cel.	Standard	2⅔ gals.	Th-Sy.		
Oakland, 6-44	Ribbon Cel.	Harrison	3½ gals.	Pump	Cent.	
Ogren	Ribbon Cel.	Livingston		Pump	Cent.	
Oldsmobile, 43A	Ribbon Cel.	Harrison	3½ gals.	Pump	Vane	
Oldsmobile, 46	Ribbon Cel.	Harrison	5 gals.	Pump	Vane	
Oldsmobile, 47	Ribbon Cel.	Harrison	3½ gals.	Pump	Cent.	
Overland, 4			3¾ gals.			
Packard, Single Six	Ribbon Cel.	Fedders	4½ gals.	Pump	Vane	Thermostat
Packard, Twin Six	Ribbon Cel.	Sp-With.	8½ gals.	Pump	Vane	Thermostat
Paige, 6-66		National	6¼ gals.	Pump	Vane	Thermostat
Paige, 6-44		National	4 gals.	Pump	Vane	
Paterson, 22-6-52	Fin. Tube	Long	4 gals.	Pump	Cent.	
Peerless, 56	Ribbon Cel.	Sparton	8½ gals.	Pump	Cent.	Thermostat Shutter
Pierce-Arrow, 33	Fin. Tube	Fedders	7½ gals.	Pump	Vane	Thermostat
Pilot, 6-50	Ribbon Cel.	Jamestown	5 gals.	Pump	Cent.	
Premier, 6-D		McCord	6 gals. 3½ qts.	Pump	Vane	Thermostat
Premocar		Jamestown	4¼ gals.	Th-Sy.		
R. & V. Knight J	Fin. Tube	Long		Th-Sy.		
R. & V. Knight R	Fin. Tube	Long	5½ gals.	Th-Sy.		
Reo	Fin. Tube	Own	3¼ gals.	Pump	Cent.	
Revere		Fedders	6 gals.	Pump	Vane	
Rickenbacker, A	Ribbon Cel.	Fedders		Pump	Cent.	
Roamer, 6-54-E		Mayo		Pump	Cent.	
Roamer, 4-75-E		Mayo		Pump	Cent.	
Rolls Royce	True Cel.	Own	9 gals.	Pump	Cent.	Shutter
Saxon, 125G	Ribbon Cel.	Fedders	4½ gals	Th-Sy.		
Sayers Six	Ribbon Cel.	Fedders	5 gals.	Pump	Cent.	
Seneca, L2 and 02	Ribbon Cel.	Kuents	3 gals.	Th-Sy.		
Seneca, 50-51	Ribbon Cel.		3½ gals.	Th-Sy.		
Sperling	Ribbon Cel.			Th-Sy.		
Standard, 8	Ribbon Cel.	Mayo	7¾ gals.	Pump	Cent.	
Stanley, 735	Fin. Tube	G. & O.				
Stanwood, A-22	Ribbon Cel.	Candler	2½ gals.	Pump	Cent.	
Stearns-Knight, 4	Ribbon Cel.	Fedders		Pump	Vane	
Stephens, 90	Ribbon Cel.	Fedders	7½ gals.	Th-Sy.		
Stevens-Duryea, E	Ribbon Cel.	G. & O.		Pump	Cent.	Thermostat
Studebaker, Big 6			4 gals.	Pump	Cent.	
Studebaker, Spec. 6			3¾ gals.	Pump	Cent.	
Studebaker, Light 6			3½ gals.	Pump	Cent.	
Stutz, K	Ribbon Cel.	Harrison	7¼ gals.	Pump	Cent.	
Templar, 445	Ribbon Cel.	Fedders	3½ gals.	Pump	Cent.	
Tulsa	Ribbon Cel.			Th-Sy.		
Velie, 58	Ribbon Cel.	Jamestown	5 gals.	Th-Sy.		
Velie, 48		McCord	4½ gals.	Pump	Vane	
Velie, 34	Ribbon Cel.	Jamestown	7 gals.	Th-Sy.		
Washington, 6	Ribbon Cel.	Fedders	4 gals.	Pump	Gear	
Westcott, C-48	Ribbon Cel.	Fedders	4¾ gals.	Pump	Vane	
Westcott, A-44	Ribbon Cel.	Fedders	4¼ gals.	Pump	Cent.	
Wills St. Claire, A-68	Fin. Tube	Own	6½ gals.	Th-Sy.		
Willys-Knight, 20		Overland	5 gals.	Th-Sy.		
Winton, 40	Ribbon Cel.	G. & O.		Pump	Cent.	Thermostat

Cel.—Cellular Cent.—Centrifugal Fin. Tube—Finned Tube Ribbon Cel.—Ribbon Cellular. Th-Sy.—Thermo siphon

Cooling Water Capacities for 1919, 1920, 1921, 1922 Passenger Cars

Motor Age Maintenance Data Sheet No. 188

MAKE AND MODEL	1919 In Gals.	1920 In Gals.	1921 In Gals.	1922 In Gals.
Allen	6¼	6¼	6¼	
Ambassador, R				5½
American, C	2½	2½	6	6
Anderson	4½	4¾	4¾	4¾
Apperson, 8	9½	9½	9	9
Auburn	3½	3¾	3½	
Bay State				
Beggs	6	6½	5½	
Biddle	4¼	4½		
Bour Davis	3½	4¾		
Brewster	7	7	7	7
Briscoe, 4-34		4	4	4
Buick, Six	5		5⅛	5⅛
Buick, Four				3¼
Cadillac	6	6	6	6
Case	4½	4½	4½	4½
Case, X				4
Chalmers	6½	6½	8	
Champion	5	5	5	5
Chandler	4	4	4	4
Chevrolet, 490	1¾	1¾	1¾	1¾
Chevrolet, FB	2⅞	2⅞	2⅞	3
Chevrolet, T	3⅛	3⅛		
Cleveland, 41	3	3	3	3
Climber	5	6	6	
Cole, 8	5¾	5¾	5¾	5¾
Columbia, Six	4	4	4⅛	2
Columbia, Challenger				
Columbia, Light 6				6
Comet	5	5		
Commonwealth	8	8	4	
Crawford	3	3	3½	6
Crow-Elkhart	6	6		
Cunningham	9	9		10
Daniels	8½	10	8½	10¼
Davis, 61-67				3
Davis, 71				3
Dixie Flyer	4	5½	5	3½
Dodge Bros	3⅝	3⅝	2⅝	2¾
Dorris, 6-80	4¾	4¾	4¾	4¾
Dort	4¾	4¾	5	5¼
Driggs				
Duesenberg				8
DuPont, A			5	
Durant, A-22				3¾
Durant, B-22				3⅛
Earl, 40				5
Elcar, K-4	5	5	4½	5
Elcar, 7-R				
Elgin, K-1	4	4	4	4
Essex	6	6	6	6
Ford	2⅞	2⅞	3	3¼
Franklin	Air Cooled			
Gardner, G			5	5
Geronimo	5	5	5	
Grant	3¾	4¼	4¼	4¼
H. C. S				
Hackett	3⅗	4		
Handley-Knight, B				5
Hanson, 60				5
Hatfield, A-42	4¼	4¾	5	5
Haynes	7½	7½		7
Haynes				7
Holmes	Air Cooled			
Hudson	4¼	4¼	4¼	4¼
Hupmobile, R	6	6	6	5½
Huffman			4	
Jackson				
Jewett				3¾
Jones	5½	6½		
Jordan	4¼	4¼	4¼	4¼
King	8	9	9	9
Kissel	6¾	6¾	6¾	6¾
Kline	8	8½	9	5½
LaFayette, 134			6	6
Leach			7	
Lexington	4¼	4¼	4⅝	4½
Liberty	6½	6½	6½	6½
Lincoln				7½
Locomobile	8	8		10
McFarlan	9	9	8	7½
Maibohm, B	3½	3½	5	3¼
Marmon, 34	5¾	5¼	5¼	5½
Maxwell	3	3½	3½	3¼
Mercer	7¼	7¼	7¼	7
Merit				4¼
Meteor			5	
Metz	3½	3½		
Mitchell	4¾	4¾		6
Moline-Knight		7¾		
Monroe			3½	3½
Moon, 6-48	5	5	5	5
Moon, 6-40	5½	5½		4½
Nash, 4				3¾
Nash, 6	5	5	4¾	
National		6½	6½	7
Nelson, E	3½	3½	3	
Noma, 1D			4¼	4¼
Norwalk, 430-KS			6	2⅝
Oakland	2¼	3	3	3½
Ogren				
Oldsmobile, 43A	3			3½
Oldsmobile, 45	5	5	4⅞	5
Oldsmobile, 47				3½
Overland, 4	3½	3½	3¾	3¾
Owen Magnetic		6¼		
Packard, Twin Six	8½	8½	8½	8½
Packard, Single Six				4½
Paige, 6-66	7½		5¾	6¼
Paige, 6-44	4½		3	4
Paterson	3½	3½	3½	4
Peerless	4½	4½	8	8½
Piedmont	3½	3½	5	
Pierce-Arrow, 33	6½	6½		7¾
Pierce-Arrow, 48	7⅞	7⅞		
Pilot, 6-50	5	5	5	5
Porter		8	9	
Premier	6		7½	6-3½ qts.
Premocar				4¼
R. & V. Knight, J		7¾	7¾	7¾
R. & V. Knight, R		5½	5½	5½
Ranger, B			7½	
Reo	3¼	3¼	3¼	3¼
Revere	10	10	6	6
Rickenbacker, A				
Roamer, 6-54	6⅛	6¼		
Roamer, 4-75				
Rock Falls, 11			8	
Rolls Royce				9
Saxon, 125G	4⅞		3¾	4½
Sayers, Six	4½	4½	5	5
Scripps Booth	3½	3		
Seneca, 50-51	3⅛	4	3½	3½
Seneca, L2 & O2				3
Singer	10½	10½		
Standard	7½	7¾	7¾	7¾
Stanley	Steam	Car		
Stanwood, A-22				2½
Star				
Stearns-Knight, SKL4	6	6		
Stephens, 90	7	7	7½	7½
Stevens-Duryea			5	
Studebaker, Big 6	4¼			4
Studebaker, Spec. 6	4½			3¾
Studebaker, Light 6	3¼			3½
Stutz	6¼	6¼		7¾
Templar, 445	4½	4½		3½
Tulsa				
Velie, 58	4¾			5
Velie, 48		4½	4½	4½
Velie, 34		4½	4½	7
Washington, 6				4
Westcott, C-48		5½		4¾
Westcott, A-44	5½	5½	5¾	4¼
Wills Sainte Claire, A-68				6½
Willys-Knight, 20			5½	5
Winton, 40	8	8	6	
Wolverine	5	5		

Exhaust Pipe Diameters for 1919, 1920, 1921, 1922 Passenger Cars

Motor Age Maintenance Data Sheet No. 189

MAKE AND MODEL	1919	1920	1921	1922
Allen, 43	2"	2"	2"	
Ambassador				2½"
American, C	2¼"	2¼"	2¼"	
American Beauty		2¼"	2¼"	
Anderson, Series 40	2½"	2¼"	2¼"	2¼"
Apperson, 8	1¾"	1¾"	1¾"	1¾"
Auburn, 6	2"	2"	2¼"	2¼"
Beggs, 20T & 21T	2½"	2¼"	2¼"	
Biddle	2¼"	2¼"		
Bour-Davis	2¼"	2¼"		
Brewster, 02	2¾"	2¾"	2¼"	2¾"
Briscoe, 4-34		1¾"	1⅜"	
Buick, 4				1¾"
Buick, 6		1¾"	1¾"	1¾"
Cadillac	1¾"	1¾"	1¾"	1¾"
Case	2¼"	2¼"		2¼"
Chalmers	2¾"	2¾"	2⅜"	
Champion	5"	5"		
Champion, Special	2⅜"	2⅜"		
Chandler	2"	2"	2"	2"
Chevrolet, 490	1½"	1½"	2"	2"
Chevrolet, FB	2"	2"	2"	2"
Chevrolet, T	2"	2"		
Cleveland, 41	2"	2"	2"	2"
Climber, S	2"	2¼"	2¼"	2¼"
Climber, K	2"	2"		
Cole, 8	2⅝"	2⅝"	2⅝"	2⅝"
Columbia, Six	2"	2"	2¼"	
Comet	2¼"	2¼"		
Commonwealth	2¼"	2¼"	2¼"	
Crawford	2¼"	2¼"	2¼"	2¼"
Crow-Elkhart	2¼"	2¼"		
Cunningham	2¼"	2¼"	2¼"	2¼"
Daniels	1¾"	1⅞"	1⅞"	1⅞"
Davis				
Dixie Flyer	2⅜"	2⅜"	1⅜"	2⅜"
Dodge Brothers	2"	2"	2"	2"
Dorris, 6-80	2½"	2½"	2½"	2½"
Dort	2¼"	2¼"	2¼"	2¼"
Duesenberg				2⅜"
DuPont			2½"	
Durant, A-22				1¾"
Durant, B-22				2¼"
Earl, 40				1¾"
Elcar, K-4	2⅜"	2⅜"	2¼"	2¼"
Elcar, 7-R				3½"
Elgin, K-1	2"	2"		2"
Essex, A	2"	2"	2"	2"
Ferris			2¼"	
Ford, T	1½"	1½"	1½"	1½"
Franklin	1½"	1½"	1½"	1½"
Gardner, G			2¼"	2¼"
Geronime	2½"	2¼"	2¼"	
Grant	1¾"	2"	2"	2"
H. C. S				
Handley-Knight				2½"
Hanson			2¼"	2¼"
Hatfield	1¾"	2"	2"	2"
Haynes	2¾"	2⅜"	2⅜"	2⅜"
Haynes, 75				2½"
Hollier	2"	2½"		
Holmes			2"	2"
Hudson	2¼"	2¼"	2¼"	2¼"
Huffman			2¼"	
Hupmobile	1¾"	1¾"	1⅞"	1¾"
Jackson				
Jordan	2¼"	2¼"	2¼"	2¼"
Kelsey				
King, K	1¾"	1¾"		1⅞"
Kissel	2¾"	2¾"	2¾"	2¾"
Kline	2"	2"	2¼"	2½"
Kurtz Automatic				2¼"
LaFayette, 134			2"	
Leach, 999			2"	3"
Lexington			2"	2"
Liberty	2"	2"	2"	2"
Lincoln				
Locomobile	2½"	2½"	2½"	2¾"
Maibohm	2"	2"	2"	2"
Marmon	2¼"	3"	3"	3"
Maxwell	1½"	1½"	1⅜"	
McFarlan	3¼"	3¼"	3¼"	3"
Mercer	3"	3"	3"	3"
Merit				2¼"
Meteor, R. & R. R			2½"	2½"
Metz	2⅜"	2⅜"	2¼"	
Mitchell	2¼"	2¼"		2⅜"
Moline-Knight	2½"	2½"		
Monitor				
Monroe			1¾"	1¾"
Moon	2½"	2¼"	2¼"	2¼"
Moon	2¼"	2¼"		
Moore	1¾"	2"		
Nash, 6	2"	2"	2"	2"
Nash, 4				2"
National		2½"	2½"	2½"
Nelson	1½"	1½"	1½"	
Noma			1½"	
Norwalk, 430-KS			2⅜"	2⅜"
Oakland	2¼"	2¼"	2¼"	2¼"
Ogren, 6				2½"
Oldsmobile, 43A	1¾"	1¾"		2"
Oldsmobile, 47	1¾"	1¾"	1¾"	1¾"
Olympian	1¼"	1¼"	1¼"	
Overland, 4	2"	2"	2"	2"
Owen Magnetic		2⅝"		
Packard, 335	2¼"	2¼"	2¼"	2¼"
Packard, Single 6				2¼"
Paige, 6-44	2"	2"	2"	2"
Paige, 6-66	2¼"	2¼"	2½"	2½"
Pan American	2¼"	2¼"		2"
Parenti				2"
Paterson	2"			2¼"
Peerless	1⅞"	1⅞"	1⅞"	1⅞"
Piedmont, 6-40				2¼"
Pierce-Arrow	2⅞"	2⅞"	2⅞"	2⅞"
Pierce-Arrow, 48	3¼"			
Pilot	2¼"	2¼"	2¼"	2¼"
Porter			2⅜"	
Premier			2"	2"
Ranger			2"	
Reo	2½"	2½"	2½"	2½"
Revere	3"	3"	3"	3"
Roamer, 6-54	2¼"	2¼"	2¼"	2¼"
Roamer, 4-75				2½"
Rock Falls			2¼"	
Rickenbacker				2¼"
R. & V. Knight, J		2½"	2½"	2½"
R. & V. Knight, R		2½"	2½"	2½"
Saxon	1¾"		2"	2"
Sayers	2"	2"	2¼"	2¼"
Scripps-Booth	2¼"	2¼"	2¼"	
Seneca	1½"	1½"	1½"	2¼"
Singer	2½"	2½"		
Standard	1⅝"	1⅝"	1⅝"	1¾"
Stanley	Steam	Car		
Stanwood				
Stearns-Knight, SKL4	2¼"	2¼"	2¼"	2¼"
Stephens	2¼"	2¼"	2¼"	2¼"
Stevens-Duryea			2½"	
Studebaker, L6	2"			1¾"
Studebaker, B6	2"	2"	2"	2"
Studebaker, S6	2"			
Stutz	3"	3"	3"	3"
Templar	2"	2"	2"	2"
Velie	2½"		2¼"	2"
Velie, 34		2"	2"	2"
Velie, 48		2¼"	2¼"	2¼"
Westcott, A-44	2¼"	2¼"	2¼"	2¼"
Westcott, C-48		2¼"	2¼"	2¼"
Wills Sainte Claire, A-68				
Willys-Knight, 20A				2"
Winton, 25	2½"	2½"	2½"	2½"
Wolverine	3"	3"		
Wasp, 2011			2¼"	
Winther			2¼"	

Shackle Bolt Data for 1920-1921-1922 Passenger Cars

Motor Age Maintenance Data Sheet No. 190

MAKE AND MODEL	YEAR	FRONT SPRINGS				REAR SPRINGS			
		Diameter of Shackle Bolt Hole		Are Spring Eyes Bushed?	Width of Spring	Diameter of Shackle Bolt Hole		Are Spring Eyes Bushed?	Width of Spring
		Front	Rear			Front	Rear		
Ambassador, R	1921-22	5/8	5/8	Yes	2 1/4	3/4	3/4	Yes	2 1/2
American, C	1922	5/8	5/8	Yes	2 1/2	5/8	5/8	Yes	2 1/2
Anderson, 40	1920-21-22	5/8	5/8	Yes	2 1/4	5/8	5/8	Yes	2 1/4
Apperson, 8	1920-21-22	5/8	5/8	Yes	1 3/4	7/8	5/8	Yes	2
Auburn	1920-21	5/8	3/4	Yes	2	5/8	3/4	Yes	2
	1922	5/8	3/4	Yes	2	7/8	3/4	Yes	2 1/4
Biddle, BL	1920-21-22	3/4	3/4	Yes	2 1/4	1	3/4	Yes	2 1/2
Brewster	1920-21-22	5/8	5/8	Yes	2	3/4	3/4	Yes	2 1/2
Buick, Six	1922	5/16	1/8	Yes	2	5/16	1/8	Yes	2 1/2
Buick, Four	1922	5/16	5/16	Yes	1 3/4	5/16	2	Yes	2
Case, X	1922	3/4	3/4	Yes	2	7/8	3/4	Yes	2 1/4
Case, V	1922	3/4	3/4	Yes	2	7/8	3/4	Yes	2 1/2
Chandler, 1922	1922	5/8	5/8	Yes	2	3/4	5/8	Yes	2 1/4
Chevrolet, 490					1 3/4				2
Cleveland, 41	1920-21-22	5/8	5/8	Yes	2	3/4	5/8	Yes	2
Cole, 870	1920-21-22	5/8	5/8	Yes	2 1/4	3/4	5/8	Yes	2 1/4
Comet, 6-C53-2	1922	3/4	3/4	Yes	2 1/4	3/4	3/4	Yes	2 1/4
Crawford									
Cunningham, V-4	1920-21-22	5/8	5/8	Yes	2 1/2	5/8	5/8	Yes	2 1/2
Daniels, D19	1922	5/8	5/8	Yes		1 11/16	1 11/16	Yes	
Dixie Flyer, H	1922	33/64	33/64		1 3/4	33/64	33/64		2
Dodge Brothers	1922	1/2	1/2	Yes	1 3/4	1/2	1/2	Yes	2
Derris, 6-80	1922	7/8	7/8	Yes	2 1/4	1	7/8	Yes	2 1/2
Dort, 19	1920	1/2	1/2	Yes	2	5/8		Yes	2
	1921-22	5/8	5/8	Yes	2	5/8		Yes	2
Duesenberg, Straight 8	1922	1 1/16	1 1/16	Yes	2 1/4	1 1/16	1 1/16	Yes	2 1/2
Durant, A-22	1922	5/8	5/8	Yes	2	5/8	5/8	Yes	2
Durant, B-22	1922	5/8	5/8	Yes	2	5/8	5/8	Yes	2 1/4
Earl, 40	1922	5/8	5/8	Yes	1 3/4	5/8	5/8	Yes	1 3/4
Elcar, K-4	1920-21-22	3/4	3/4	No	2	3/4	3/4	No	2 1/2
Elcar, 7R	1920-21-22	3/4	3/4	No	2	3/4	3/4	No	2 1/2
Elgin, K-1	1922	3/4	3/4	No	2	3/4	3/4	No	2 1/4
Essex	1920-21-22	5/8	5/8	Yes	2	3/4	5/8	Yes	2
Ford, T	1922	37/64	37/64	Yes	1 31/64	37/64	37/64	Yes	1 63/64
Franklin, 9B	1920-21-22	3/4	3/4	Yes	6	3/4	3/4	Yes	6
Gardner	1921-22	5/16	5/16	Yes	1 3/4	3/4	5/16	Yes	1 3/4
Grant	1922	3/4	3/4	Yes	2	1	1	Yes	2
Halladay, Four	1922	5/8	5/8	Yes	1/4	5/8	5/8	Yes	3/4
Halladay, Six	1922	5/8	5/8	Yes	1/4	5/8	5/8	Yes	3/4
Handley Knight, B	1922	3/4	3/4	Yes	5/16	1 1/4	3/4	Yes	9/32
Hatfield, A-42	1922	5/8	5/8	Yes	2	3/4	3/4	Yes	2
Haynes, 55	1922	3/4	3/4	Yes	2 1/4	1 3/4	1 3/4	Yes	2 1/4
Haynes, 75	1922	3/4	3/4	Yes	2 1/4	1 3/4	1 3/4	Yes	2 1/4
Holmes, Series	1920-21-22	3/4	3/4	Yes	1 3/4	3/4	3/4	Yes	1 3/4
Hudson, Super Six	1920-21-22	1 1/16	1 1/16	Yes	2 5/16	3/4	1 1/16	Yes	2 5/16
Hupmobile, R	1920-21-22	1/2	1/4	Yes	1 3/4	1/2	1/2	Yes	2
Jordan, MX	1922	5/8	5/8	Yes	2	7/8	5/8	Yes	2
King, 8	1922	5/8	5/8	Yes	2	5/8	5/8	Yes	2 1/2
Kissel	1922	3/4	3/4	Yes	2	3/4	3/4	Yes	2 1/4
Kline	1920-21-22	3/4	3/4	Yes	2	3/4	3/4	Yes	2
LaFayette	1920-21-22	7/8	7/8	Yes	2 1/4	7/8	7/8	Yes	2 1/2
Leach, 999	1921	5/8	5/8	Yes	2 1/4	3/4	5/8	Yes	2 1/4
	1922	5/8	5/8	Yes	2 1/4	1	5/8	Yes	2 1/4

MAKE AND MODEL	YEAR	FRONT SPRINGS				REAR SPRINGS			
		Diameter of Shackle Bolt Hole		Are Spring Eyes Bushed?	Width of Spring	Diameter of Shackle Bolt Hole		Are Spring Eyes Bushed?	Width of Spring
		Front	Rear			Front	Rear		
Lexington	1922	5/8	5/8	Yes		5/8	3/4	Yes	
Locomobile	1922	3/4	3/4	Yes	2	7/8	7/8	Yes	2 1/4
Maibohm, B	1922	1/2	1/2	Yes	1 3/4	3/4	1/2	Yes	2 1/4
Marmon, 34	1922	5/16	5/16	Yes	2	5/16	5/16	Yes	2 1/2
Mercer	1920-21-22	1	1	Yes	2 1/2	1	1	Yes	2 3/4
McFarlan, TV	1922	3/4	3/4	Yes	2 1/4	1 1/4	1	Yes	2 1/2
Merit	1920-21	5/8	5/8	Yes	2	5/8	5/8	Yes	2
	1922	7/8	5/8	Yes	2 1/2	7/8	5/8	Yes	2 1/2
Mitchell	1922	5/16	5/16	Yes	2	5/16	5/16	Yes	2 1/2
Monroe	1920-21-22	5/16	5/16	Yes	1 3/4	1 1/16	1 1/16	Yes	2
National, BB	1920-21-22	1/2	5/8	Yes	2	3/4	5/8	Yes	2 1/2
Norwalk, 4-30-KS	1922	3/4	3/4	No	1 3/4	3/4	3/4	No	2
Oakland, 6-44	1920-21-22	5/8	5/8	Yes	1 3/4	3/4	5/8	Yes	1 3/4
Ogren, Six	1922	5/8	5/8	Yes	2 1/4	5/8	1	Yes	2 1/2
Oldsmobile, 43	1922	3/4	3/4	Yes	2	3/4	3/4	Yes	2 1/4
Oldsmobile, 47	1922	3/4	3/4	Yes	2	3/4	3/4	Yes	2 1/4
Oldsmobile, 46	1922	3/4	3/4	Yes	2 1/4	3/4	3/4	Yes	2 1/4
Overland, 4	1922	3/4	5/16	Yes	2	3/4	5/16	Yes	2
Packard, Twin Six	1920-21-22	5/8	5/8	Yes	2 1/4	3/4	5/8	Yes	3
Packard, Single Six	1921-22	3/4	3/4	Yes	2	3/4	3/4	Yes	2 1/4
Paige, 6-66	1922			Yes	2			Yes	2 1/2
Paige, 6-44	1922			Yes	2			Yes	2 1/4
Paterson, 6-22-50	1922	5/8	5/8	Yes	2	5/8	5/8	Yes	2 1/2
Peerless, 56	1922	1/2	1/2	Yes	1 3/4	1/2	1/2	Yes	1 3/4
Pierce Arrow	1920-21	11/16	11/16	Yes	2	3/4	3/4	Yes	2 3/4
	1922	3/4	3/4	Yes	2	3/4	3/4	Yes	2 3/4
Pilot, 6-50	1921-22	3/4	3/4	Yes	2	3/4	3/4	Yes	2 1/2
Premier, 6-D	1922	5/8	5/8	Yes	2 1/4	3/4	5/8	Yes	2 1/4
R. & V. Knight, R	1920-21-22	5/8	5/8	Yes	2	7/8	5/8	Yes	2 1/4
R. & V Knight, J	1920-21-22	5/8	5/8	Yes	2	7/8	5/8	Yes	2 1/4
Roo	1920-21-22	5/8	5/8	Yes	2	7/8	7/8	Yes	2
Revere	1920-21-22	5/8	5/8	Yes	2 1/4	7/8	5/8	Yes	2 1/2
Rickenbacker, A	1922	3/4	3/4	Yes	2	3/4	3/4	Yes	2 1/2
Roamer, 4-75-E	1920-21-22	5/8	5/8	Yes	2	5/8	1	Yes	2
Roamer, 6-54-E	1920-21-22	5/8	5/8	Yes	2	5/8	1	Yes	2
Rolls Royce	1922	7/8	7/8	Yes	2	7/8	None	Yes	2 1/2
Saxon, 125G	1922	5/8	5/8	Yes	2	5/8	5/8	Yes	2
Sayers	1920-21-22	5/8	5/8	No	2	5/8	5/8	No	2
Seneca, L2 & O2	1922	1/2	1/2	No	1 3/4	5/8	None	No	2
Seneca, 50-51	1922	5/8	5/8	Yes	2	5/8	5/8	Yes	2
Standard	1920-21-22	3/4	3/4	Yes	2 1/4	3/4	3/4	Yes	2 1/2
Stanley Steamer	1920-21-22	15/16	1 1/8	Yes	2			Yes	2
Stanwood	1920-21-22	5/8	5/8	Yes	2	5/8	5/8	Yes	2
Stearns Knight, SKL4	1922	5/8	5/8	Yes	2 1/2	5/8	5/8	Yes	2 1/2
Stephens	1920-21-22	5/8	5/8	Yes	2	3/4	5/8	Yes	2 1/4
Stutz	1920	1/2	1/2	Yes	2	1/2	1/2	Yes	2
	1921-22	3/4	3/4	Yes	2	3/4	3/4	Yes	2
Templar	1920-21-22	7/8	7/8	Yes	2	7/8	7/8	Yes	2 1/4
Velie, 34	1921-22	3/4	3/4	Yes	1 3/4	7/8	3/4	Yes	2
Velie, 58	1922	3/4	3/4	Yes	1 3/4	7/8	3/4	Yes	2
Velie, 48	1920-21-22	3/4	3/4	Yes	2	1	3/4	Yes	2
Willys-Knight, 20A	1922	7/8	5/8	Yes	2	3/4	5/8	Yes	2 1/4

NOTE—The shackle bolt hole diameter given in the specifications is the diameter of the shackle bolt. The hole is from .002 to .003 larger than the bolt, to allow for free movement and the necessary film of lubricant.

Under the column heading "Width of Spring" the actual width of spring is given and not the shackle bolt overall length. The overall of bolt will equal the width of the spring plus the thread length.

Lubrication Systems on 1922 Passenger Cars

Motor Age Maintenance Data Sheet No. 191

MAKE AND MODEL	System	Type of Pump	Normal Pressure at 1,000 R. P. M. in lbs. per sq. in.	Relief Spr in Set to	Recommended Grade of Oil	Capacity of Crank-Case
Ambassador, R	Hollow Crks	Gear			Heavy	
Anderson, 40	Hollow Crks	Gear	30	40 lbs.	Medium	6 qts.
Apperson, Eight	Hollow Crks	Gear	12	30 lbs.		
Auburn, 6-51	Hollow Crks	Gear	25	25 lbs.		
Bay State, 1	Hollow Crks	Gear	15	40 lbs.		
Biddle, B1, B5	Cir. Splash	Gear				
Brewster, 02	Hollow Crks	Gear	15	50 lbs.		
Buick, Six	Cir. Splash	Gear	5	5 lbs.	Medium	6 qts.
Buick, Four	Cir. Splash	Gear	5	5 lbs.	Medium	4 qts.
Cadillac, 61	Hollow Crks	Gear		6 lbs.		8 qts.
Case, X	Hollow Crks	Gear	10	10 lbs.		6 qts.
Chalmers, 35C	Cir. Splash	Gear	12	20 lbs.		
Chandler, 1922	Cir. Splash	Piston			Medium	8 qts.
Chevrolet, Superior	Cir. Splash	Gear	3		Medium	4 qts.
Chevrolet, FB	Cir. Splash	Gear			Medium	5 qts.
Cleveland, 41	Cir. Splash	Gear	5	5 lbs.	Medium	6 qts.
Cole, 870	Cir. Splash	Gear	15			
Columbia, DeLuxe	Cir. Splash	Gear	15			7 qts.
Columbia, Challenger	Cir. Splash	Gear				
Columbia, Light 6	Cir. Splash		15			6 qts.
Comet, C53-2	Cir. Splash	Piston	15			7 qts.
Crawford, 22-6-60	Cir. Splash				Heavy	6 qts.
Cunningham, V	Hollow Crks	Gear	25	25 lbs.		
Daniels, D19	Fuel Force	Gear	20		Heavy	8 qts.
Davis, 71	Hollow Crks	Gear	15	30 lbs.	Medium	5 qts.
Davis, 61-67	Hollow Crks	Gear	25	25 lbs.	Medium	6 qts.
Dixie Flyer, H	Cir. Splash	Gear	10	12 lbs.		
Dodge Bros.	Cir. Splash	Gear			Medium	6 qts.
Derris, 6-80	Hollow Crks	Gear	30		Medium	10 qts.
Dort, 19	Cir. Splash	Piston				5 qts.
Driggs, 1922	Cir. Splash	Gear	5			
Duesenberg	Hollow Crks	Gear	30			
DuPont, A	Hollow Crks	Gear	30	30 lbs.		
Durant, A-22	Cir. Splash	Gear	6	None		5 qts.
Durant, B-22	Hollow Crks	Gear	30	50 lbs.	Medium	6 qts.
Earl, 40	Cir. Splash	Piston	4			6 qts.
Elcar, K-4	Cir. Splash	Piston				
Elcar, 7-R	Hollow Crks	Gear	15			7 qts.
Elgin, K-1	Force	Eccentric				
Essex	Cir. Splash	Piston			Medium	4 qts.
Ford, T	Cir. Splash	Flywheel			Light	
Franklin, 9-B	Hollow Crks	Gear	5	16 lbs.	Medium	5 qts.
Gardner, T, R. & G.	Cir. Splash	Piston	5		Medium	5 qts.
Grant	Cir. Splash	Gear	15	15 lbs.		2 gals.
H. C. S.	Hollow Crks	Gear				
Halladay, 4	Hollow Crks	Gear	10			
Halladay, 6	Cir. Splash	Eccentric	6			
Handley-Knight, B	Hollow Crks	Eccentric	30		Medium	8 qts.
Hanson, 60	Hollow Crks	Gear	15	30 lbs.		
Hatfield, A-42	Cir. Splash	Gear	10	25 lbs.		6 qts.
Haynes, 55	Cir. Splash	Piston		3 lbs.	Medium	7 qts.
Haynes, 48	Hollow Crks	Gear	20	35 lbs.	Medium	7 qts.
Haynes, 75	Hollow Crks	Gear	25	40 lbs.	Medium	8 qts.
Holmes, 4	Cir. Splash	Gear	8	None	Heavy	8 qts.
Hudson Super 6	Cir. Splash	Piston			Medium	7 qts.
Hupmobile, R	Hollow Crks	Gear	8	8 lbs.		
Jackson, 638	Hollow Crks	Gear	15			7 qts.
Jewett, Six	Hollow Crks	Gear	30	35 lbs.	Medium	6 qts.
Jordan, MX	Hollow Crks	Gear	15	15 lbs.		
King, K	Hollow Crks	Gear	25	30 lbs.		7 qts.
Kissel, 45	Cir. Splash	Gear	7			6 qts.
Kline, 6-55-K	Hollow Crks	Gear	30	35 lbs.	Light	4 qts.
LaFayette, 134	Hollow Crks	Gear			Medium	7 qts.
Leach, 999	Hollow Crks	Gear				6 qts.
Lexington, ST-22	Hollow Crks	Gear	40	40 lbs.		
Lexington, T-22	Hollow Crks	Gear	40	40 lbs.		
Liberty, 16-D	Pressure	Gear			Medium	6 qts.
Lincoln	Hollow Crks	Gear	13	20 lbs.	Medium	10 qts.

MAKE AND MODEL	System	Type of Pump	Normal Pressure at 1,000 R. P. M. in lbs. per sq. in.	Relief Spring Set to	Recommended Grade of Oil	Capacity of Crank-Case
Locomobile, 48	Pressure	Gear	2	3 lbs.	Medium	7 qts.
McFarlan, T. V.	Hollow Crks	Gear	30	60 lbs.	Heavy	6 qts.
Maibohm, B	Cir. Splash	Piston	4			
Marmon, 34	Hollow Crks	Gear	14		Medium	12 qts.
Maxwell	Cir. Splash				Medium	4 qts.
Mercer, Series 5	Hollow Crks	Gear	15			
Merit	Hollow Crks	Gear	15	12 lbs.		7 qts.
Mitchell, F-50	Cir. Splash	Piston				7 qts.
Monroe	Hollow Crks	Gear	20			
Moon, 6-40	Hollow Crks	Gear	25			6 qts.
Moon, 6-58	Hollow Crks	Gear	25			7 qts.
Nash, Four	Cir. Splash	Gear	3			6 qts.
Nash, Six	Cir. Splash	Gear				
National	Hollow Crks	Gear	15			
Noma, 1D	Hollow Crks	Piston	20			
Noma, 3C	Hollow Crks	Piston	15			
Norwalk, 4-30KS	Cir Splash	Piston	5			5 qts.
Oakland, 6-44	Hollow Crks	Gear	10	12 lbs.		4 qts.
Ogren, Six	Pressure	Gear	20			
Oldsmobile, 46	Hollow Crks	Gear	10	25 lbs.		6 qts.
Oldsmobile, 43A	Cir. Splash	Gear	4	6 lbs.		6 qts.
Oldsmobile, 47	Hollow Crks	Gear	10	25 lbs.	Medium	6 qts.
Overland, 4	Cir. Splash	Flywheel			Medium	6 qts.
Packard, Single 6	Hollow Crks	Gear	23	23 lbs.		6 qts.
Packard, Twin 6	Hollow Crks	Gear	25	25 lbs.		10½ qts.
Paige, 6-66	Hollow Crks	Gear	15	50 lbs.	Medium	8 qts
Paige, 6-44	Cir. Splash	Piston	3		Medium	8 qts.
Paterson, 22-6-52	Hollow Crks	Gear	16	20 lbs.		
Peerless, 56	Hollow Crks	Gear	15	15 lbs.		
Pierce-Arrow	Hollow Crks	Gear	12		Medium	9 qts.
Pilot, 6-50	Cir. Splash	Gear	15	25 lbs.		6 qts.
Premier, 6-D	Hollow Crks	Gear				6 qts.
Premocar	Cir. Splash	Gear				
R. & V. Knight, J	Hollow Crks	Gear	20	20 lbs.		
R. & V. Knight, R	Hollow Crks	Gear	20	20 lbs.		
Reo, T6 & U6	Hollow Crks	Piston			Medium	8 qts.
Revere	Hollow Crks	Gear	15	15 lbs.		
Rickenbacker	Hollow Crks	Gear	25	60 lbs.		
Roamer, 6-54-E		Piston	6	4 lbs.		7 qts.
Roamer, 4-75-E	Hollow Crks	Gear	20			
Rolls Royce	Hollow Crks	Gear	22			
Saxon, 125-G		Gear			Medium	6 qts
Sayers, Six	Hollow Crks	Gear	15	20 lbs.		7 qts.
Seneca, L2 & O2	Cir. Splash	Piston			Medium	5 qts.
Seneca, 50-51	Cir. Splash	Piston	6		Medium	5 qts
Sperling	Hollow Crks	Gear	10	22 lbs.	Medium	8 qts.
Standard	Hollow Crks	Gear	30	30 lbs.		
Stanley, 735	Cir. Splash	Piston				
Stanwood, A-22	Pressure	Gear	15	20 lbs.		7 qts.
Stearns-Knight, 4	Hollow Crks	Gear	25	100 lbs.		
Stephens, 90	Hollow Crks	Gear	20	25 lbs.		
Stevens-Duryea, E	Cir. Splash	Gear	5	5 lbs.		
Studebaker, Big 6	Cir. Splash	Gear			Medium	6 qts.
Studebaker, Spec. 6	Cir. Splash	Gear			Medium	6 qts.
Studebaker, L6	Cir. Splash	Gear			Medium	6 qts.
Stutz, K	Cir. Splash	Piston		18 lbs.	Medium	12 qts.
Templar, 445	Hollow Crks	Gear	20	20 lbs.	Heavy	6 qts.
Tulsa	Cir. Splash	Gear	20			
Velie, 58	Hollow Crks	Gear	15	20 lbs.		5 qts.
Velie, 48	Hollow Crks	Gear	15			6 qts.
Velie, 34	Cir. Splash	Gear				4 qts.
Washington, 6	Cir. Splash	Gear	15			7 qts.
Westcott, C-48	Cir. Splash		5	9 lbs.	Medium	7 qts.
Westcott, A-44	Hollow Crks	Gear	20	12 lbs.	Light	7 qts.
Wills Sainte Claire	Hollow Crks	Gear	5		Heavy	8 qts.
Willys-Knight	Cir. Splash				Medium	6 qts.
Winton, 40	Hollow Crks	Gear	25	30 lbs.		

COMING MOTOR EVENTS

AUTOMOBILE SHOWS

Wash'gton,	City of Enclosed Car Salon	Oct. 21-28
Houston	South Texas Fair	Nov. 8-18
Jersey City	Third Annual Automobile Show	Nov. 11-18
Los Angeles	Automobile Show, Motor Car Dealers' Association	Nov. 11-18
Chicago	Annual Show of the Automotive Equipment Association	Nov. 13-18
Cincinnati, O.	Second Annual Automobile and Radio Exposition	Nov. 23-29
New York	Eighteenth Annual Automobile Salon	Dec. 3-9
New York	Annual Show	Jan. 6-13
New York	National Automobile Body Builders' Show	Jan. 8-13
Cleveland, O.	Annual Winter Show, Cleveland Automobile M'f'r's' and Dealers' Assn.	Jan. 20-27
Chicago	Annual Show at Coliseum N. A. C. C.	Jan. 27-Feb. 3
Chicago	Annual Automobile Salon	Jan. 27-Feb. 3
Ann Arbor, Mich.		Jan. 29-Feb. 3
Minneapolis, Minn.	Annual Show	Feb. 3-10
Lansing, Mich.		Feb. 5-10
Kalamazoo, Mich.		Feb. 12-17
Flint, Mich.		Feb. 12-17
Gr'd Rapids, Mich.		Feb. 19-24
Mt. Clemens, Mich.		Feb. 19-24
Des Moines, Ia.	Annual Show	Feb. 23-Mar. 3
Brooklyn, N. Y.	Annual Automobile Show of the Brooklyn Motor Vehicle Dealers' Association	Feb. 24-Mar. 3
Muskegon, Mich.		Feb. 26-Mar. 3
Syracuse, N.Y.	Annual Automobile Show	Feb. 26-Mar. 3
Springfield, Mass.	Annual Automobile Show	Feb. 26-Mar. 3
Bay City, Mich.		Mar. 5-10
Newark, N. J.	Annual Automobile Show	Mar. 10-17
Port Huron, Mich.		Mar. 12-17
Battle Creek, Mich.		Mar. 19-24
Alpena, Mich.		Apr. 2-7

CONVENTIONS

Washington	Second Annual Conference of the Highway Education Board	Oct. 2-28
Chicago	Annual Meeting Automotive Equipment Association	Nov. 13-18
Toledo	Annual Convention of the Ohio Automotive Trades' Assn.	Dec. 6-8

FOREIGN SHOWS

London	Annual Show	Nov. 3-11

RACES

San Carlos, Calif.—500-Mile Armistice Day Race	Nov. 11
Los Angeles, Calif.	Nov. 30
San Diego, Calif.	January

SQUEEKS & RATTLES

If You Know Any, Tell Them to Us

DON'T YOU DO IT

Not long ago we asked a dealer friend, what he
Intended to do when Jack and his partner came
Rushing in. He said he hadn't had time to
Think of the winter and anyway he believed it
Would all be summer for him because he had made
Plenty of jack during the big rush and he
Wasn't particularly worried about Frost and the
Coal bill. That's all right for the guys who
Want to feel that way, but you know the one
About the bird who never carried an umbrella
And it started to rain on his new "all wool"?
And when he got home, he found that he had
Paid forty bucks for a suit of underwear—?

J. V. M.

Report on Employment Situation

Spark Plug—"I got fired today."

Battery—"That's nothing. I'm discharged, too."—(Science & Invention.)

MAYBE IT WAS STOLEN

Hubby—"Oh, Lord, one cylinder's missing."
Wifey—"Oh, dear, where could we have lost it?"

Many Feet

Rattle, rattle, little car,
How I wonder what you are—
Service rates are pretty high,

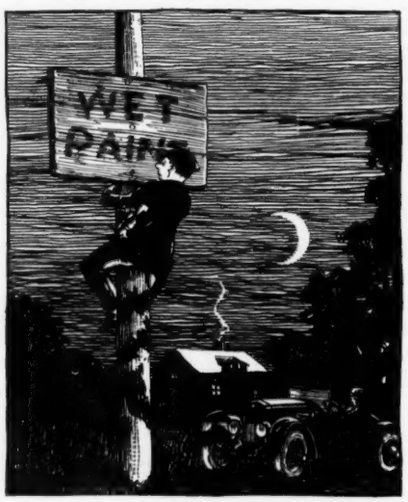
I can fix you if I try.
Sputter, sputter, little car,
Tell me what your troubles are,
For I'll know without a doubt,
When I turn you wrong side out.

Start and stop, you blank blank car,
Now I know just what you are,
I will tow you into town,
Service rates are coming down.

—R. Evans Black, Waterloo, Ia.

Another reason why the motor car is gaining on the steam and electric railroads as a means of travel is that a roadmap is a durn sight easier to read than a timetable.

SALES TIPS—



The Guy Who Didn't Need A Spotlight

Our Advertising Suggestion

One used car with a piston ring,
Two rear wheels, one front spring.
Has no fenders, seat nor plank,
Burns much gas and hard to crank.
Carbureter's busted halfway through,
Engine's missing; hits on two.
Three years old, four in the spring;
Shock absorbers, 'n' everything.
Radiator's busted, sure does leak;
Differential's dry, can hear it squeak.
Ten spokes missing, front all bent;
Tires blowed out, 'taint worth a cent.
Got lots o' speed, runs like the deuce,
Burns either gas or tobacco juice.
Tire's all off; been run on the rim—
But it's a d—— good car for the shape it's in.

Specifications of Current Motor Truck Models

NAME AND MODEL	Tons Capacity	Chassis Price	Bore and Stroke	TIRES Front	TIRES Rear	Final Drive
Acason	¾–1	$1650a	3¾x5	34x5n	34x5n	W
Acason...RB	1½	1950	3¾x5¼	36x3½	36x6	W
Acason...H	2½	2750	4⅜x5¾	36x4k	36x8k	W
Acason...L	3½	3450	4⅜x5¾	36x5k	36x10k	W
Acason...M	5	4350	5 x8¼	36x6	40x12	W
Ace	1½–1½	2400	3⅝x5	34x3½	34x6	W
Ace	2	2850	4½x5¼	36x4	36x7	W
Ace	2½–3	3400	4½x5¼	36x4	36x8	
Acme	1	....	3¾x5	35x5n	35x5n	W
Acme	1½	....	3¾x5	34x3½	34x5	W
Acme	2	....	3¾x5	34x3½	34x5	W
Acme	3	....	4½x5¼	36x4	36x7	W
Acme	3	....	4½x5½	36x4	36x7k	W
Acme	4¼	....	4½x5½	36x5	40x10	W
Acme	6¼	....	4¾x6	36x6	40x12	W
American	2½	3350	4 x6	36x4k	36x4dk	W
American	4	4275	4½x6	36x5k	36x5dk	W
American	5	4500	4½x6	36x5	36x12	W
Armleder	1	....	3¾x5¼	34x3½k	34x6k	W
Armleder	1½	....	3¾x5¼	34x3½k	34x6k	W
Armleder...40-B	1½	....	1¼x5½	34x3½k	34x6k	W
Armleder...40-C	1½	....	4⅛x5¼	34x3½k	34x6k	W
Armleder..HW-B	2½	....	4¼x5½	36x4k	36x7k	W
Armleder..HW-C	2½	....	4⅛x5¼	36x4k	36x7k	W
Armleder..KW-B	3½	....	4½x6	36x5k	36x5dk	W
Armleder..KW-C	3½	....	4½x5½	36x5k	36x5dk	W
*Atlas	2	1435	3¾x5⅛	31x4½n	34x4½n	W
*Atlas...44	1½–2	1950	3¾ 5⅛	36x6n	36x6n	W
Atterbury...20R	1½	2175	3¾x5	34x3½	34x5	W
Atterbury...22C	2½	3375	4⅛x5¼	36x4	36x4d	W
Atterbury...22C	2½	3475	4⅛x5¼	36x4	36x4d	W
Atterbury...22D	3½	4275	4½x5½	36x5	40x5d	W
Atterbury...22D	3½	4375	4½x5½	36x5	40x5d	W
Atterbury...8E	5	4975	4¾x6	36x5	40x6d	W
Atterbury...8E	5	5125	4¼x6	36x5	40x6	W
Autocar...21UF	1½–2	1950	4¼x4½t	34x4k	34x6	D
Autocar...21UG	1½–2	2050	4¼x4½t	34x4k	34x6	D
Autocar...27H	2-3	2950	4 x5½	34x5	36x7	D
Autocar...27K	2-3	3075	4 x5½	34x5	36x7k	D
Autocar...26Y	4-6	3950	4¼x5½	34x6	36x12	D
Autocar...26-B	4-6	4100	4¼x5½	34x6	36x12	D
Available...H1½	1½	2475	4 x5	36x3½k	36x5k	W
Available...H2	2	2775	4 x5	36x3½k	36x6k	W
Available...H2½	2½	3160	4 x5	36x4k	36x8k	W
Available...H3½	3½	4175	4½x5½	36x5	40x5d	W
Available...H5	5	5375	5 x6	36x6	40x12	W
*Avery	1	....	3 x4s	34x5n	34x5n	I
Beck...A Jr.	1¼	1285a	3½x5	31x4½n	34x4½n	I
Beck...B-30	1½	1350	3¾x5	34x5	36x6	
Beck...C-40	2	1550	3¾x5	36x6	36x6	
Beck...D-50	2½	1950	4⅛x5¼	38x7	40x8	
Bell...M (Iowa)	1	1495	3⅝x5⅛	35x5	35x5n	W
Bell...E (Iowa)	1½	2100	3¾x5¼	34x3½	34x5	I
Bell...O (Iowa)	2½	2550	4¼x5½	34x4	34x6	I
Bessemer...G	1	....	3½x5	35x5n	35x5n	I
Bessemer...H-2	1½	....	3¾x5	36x3½	36x5	D
Bessemer...J-2	2½	....	4⅛x5¼	36x4	36x4d	D
Bessemer...K-2	4	....	4½x5½	36x5	36x10	I
Bethlehem...KN	1	1195	3½x5	35x5n	35x5rf	B
Bethlehem...GN	2	1795	4 x5¼	34x4	34x6k	I
Bethlehem...GN	3	2195	4 x5¼	36x4k	36x8k	I
Bridgeport...A	1½	....	3⅝x5⅛	34x3½	34x6	W
Bridgeport...B	2½	....	4¼x5½	36x4	36x4d	W
Bridgeport...C	3½	....	4½x6	36x5	36x10	W
Brinton...C	2	2500	3¾x5	34x4	34x5	W
Brinton...D	3	2975	4¼x5¼	36x4	36x7	W
Brockway...E	1	....	4 x5	33x5n	33x5n	B
Brockway...S-5	1½	....	4 x5	36x4	36x6	W
Brockway...SK	1½	....	4⅛x5¼	36x4	36x6	W
Brockway...KR	2½	....	4½x5½	36x4	36x8	W
Brockway...K-5	2½	....	4⅛x5¼	36x4	36x8	W
Brockway...RT	3½	....	4¾x6	36x5	36x10	W
Brockway...R-4	3½	....	4½x5½	36x5	36x5d	W
Brockway...T-4	5	....	4¾x6	36x6	40x6d	W
*Buick	½	945b	3⅝x4¾	31x4n	31x4n	B
Case	2	....	4¼x5¾	36x6	38x7	I
*Chevrolet	¼	510b	3 x4	30x3½n	30x3½n	B
*Chevrolet...G	¾	650	3 x4	34x4n	34x4½n	B
*Chevrolet...T	1	1095	3 x5¼	33x4n	35x5n	W
Chicago...C1½	1½	....	4 x5	36x3½k	36x5k	W
Chicago...C2½	2½	....	4 x5	36x4k	36x7k	W
Chicago...C3½	3½	....	4½x5½	36x5	36x10	W
Chicago...D5	5	....	4½x5½	36x6	40x12	W
Clydesdale...10	¾–1½	1485	3¾x5	34x5n	34x5n	B
Clydesdale...10A	¾–1½	1535	3¾x5	34x5n	34x5n	B
Clydesdale...18	¾–1½	1890	3¾x5	34x5	34x5	W
Clydesdale...20	1–1½	2385	3¾x5	34x5	34x5k	W
Clydesdale...42	1½–2	2475	3¾x5	36x3½	36x6	W
Clydesdale...65X	2½–3	3250	4⅛x5¼	36x4	36x8	W
Clydesdale...65EX	2½–3	3450	4½x5½	36x4	36x8	W
Clydesdale...90	3½–4½	4100	4½x5½	36x5	36x10	W
Clydesdale...120	5–6	4500	4¾x6	36x6	40x12	W
Comet	T 1½	1950	3¾x5	34x4	34x4	W
Commerce...9	¾–1½	1150	3¾x5	32x4½n	32x4½n	B
Commerce...T	¾–1½	1450	3¾x5	34x4½n	34x4½n	B
Commerce...10	¾–1½	2500	3¾x5	33x5n	33x5n	B
Commerce...12	1½	1695	3¾x5	34x3½	34x4	I
Commerce...12	1½	1800	3¾x5	35x5n	35x5n	I
Commerce...16	2	1995	3¾x5	34x4	34x6	I
Commerce...16	2	2150	3¾x5	35x5n	36x6n	I
Commerce...18	2½	2150	4½x5¼	36x4	36x7	I
Commerce...18	2½	2495	4½x5¼	36x6n	40x8n	I
Commerce...25	2½	2425	4½x5¾	36x4	36x7	W
Commerce...25	2½	2770	4½x5¾	36x6	40x8n	W
Cook...51	2½	3600	4 x5½	36x6n	40x8n	W
*Corbitt	¾–1	1250	3½x5	33x5n	33x5n	
Corbitt...E-22	1	1180	3¾x5	34x3½	34x4	W
Corbitt...D-22	1½	2200	3¾x5	34x3½	34x5	W
Corbitt...C-22	2	2600	4½x5¾	36x3½	36x7	W
Corbitt...B-22	2½	3000	4½x5¼	36x4	36x7	W
Corbitt...R-22	3	3200	4½x5½	36x4	36x8	W
Corbitt...A-22	3½–4	3800	4½x5½	36x5	36x10	W
Corbitt...AA-22	5	4500	4¾x6	36x6	40x6d	W
Day-Elder...AS	1	1600	3¾x5	35x5n	35x5n	W
Day-Elder...B	1½	2000	3¾x5	34x3½	34x5	W
Day-Elder...D	2	2400	4½x5¼	36x4	36x7	W
Day-Elder...C	2½	2750	4¼x5½	36x4	36x7	W
Day-Elder...F	3½	3150	4½x5½	36x5	36x5d	W
Day-Elder...E	5	4250	4½x6	36x5k	40x6dk	W
Dearborn...E	1	1600	3⅝x5⅛	35x5n	35x5n	W
Dearborn...FX	1½	2300	3¾x5⅛	34x4	34x5	W
Dearborn...F	1½	2180	3¾x5⅛	34x4	34x5	W
Dearborn...48	2	2590	3¾x5⅛	34x4½n	34x7	W
Defiance...G	1	1525	3¾x5	35x5n	35x5n	B
Defiance...D	1½	1815	3¾x5	35x5n	36x6n	I
Defiance...E	2	2075	3¾x5	35x5n	38x7n	I
Denby...31	1¼	1485	3¾x5	35x5n	35x5n	B
Denby...33	1½	2145	3¾x5	35x5n	38x7n	I
Denby...37	2½–3	2795	4⅛x5¼	36x4	36x7	I
Denby...27	4	3895	4½x5½	36x5	36x5d	I
Denby...210	5	4295	4½x5½	36x6	40x6d	I
Dependable...A	¾–1	1650	3⅝x5⅛	34x5n	36x6n	W
Dependable...C	2	2350	3¾x5¼	34x3½	34x5	W
Dependable...D	2½	2650	4 x5½	34x5	36x6	W
Dependable...E	3	2950	4¼x5½	36x4	36x7	W
Diamond T...O-3	1–1¼	1975	3¾x5¼	36x3½n	36x4n	W
Diamond T...T	1½	2250	3¾x5¼	36x3½	36x5	W
Diamond T...U	2–2½	2650	4 x5¼	36x4	36x7	W
Diamond T...K	3½	3750	4¼x5½	36x5	36x5d	W
Diamond T...EL	5	4325	4½x5½	36x6	40x6d	W
Diamond T...S	5	4500	4¾x6	36x6	40x6d	W
Doane	2½	4100b	4¼x5¾	36x5	36x7	C
Doane	3½	5100b	4¾x5¾	36x5	36x5d	C
Doane	6	6000b	5 x6¼	36x6	40x6d	C
*Dodge Brothers	¾	730	3⅞x4½	32x4n	32x4n	B
Dorris...K-2	1	2490	4 x5½	33x5n	33x5n	B
Dorris...K-4	2–2½	3400	4¼x5½	36x4	36x7	W
Dorris...K-7	3½	4400	4¼x5½	36x5	36x10	W
*Dort	½	685a	3½x5	31x4n	34x4n	B
Double Drive...B	3	4000	4¼x5½	36x6	36x6	W
Duplex...A	2	2775	4 x5¼	35x5n	38x7n	W
Duplex...E	3½	3500	4¾x5½	36x8	36x8	I
Duty	2	1590	3½x5	34x3½	34x5	I
Eagle...101	1½	1875	3⅝x5¼	34x5	34x5	I
Eagle...100-2	2	2275	3¾x5¼	34x4k	34x7k	I
F. W. D...B	3	4200	4¾x5½	36x6	36x6	B
Fageol	1½	1½	3000	3¾x5¼	34x3½k	34x6k	W
Fageol	2½	2½	3900	4⅜x5¾	34x4	36x7	W
Fageol	3½	3½	5000	4½x5½	36x5k	40x5dk	W
Fageol	5	5	5700	4½x5½	36x6	40x6d	W
Fargo	R	2	1700	3¾x5	36x4	36x6	I
*Federal	1½	1375	3¾x5	—x5n	—x5n	
Federal	SD	1½	1800	3¾x5	35x5n	36x6n	W
Federal	TE	1½	2175	4½x5¼	36x3½	36x5	W
Federal	UE	2–2½	2425	4½x5¼	36x4	36x7	W
Federal	WE	3½–4	3150	4½x5½	36x5	36x5d	W
Federal	X2	5–6	4500	4¾x6	36x6	40x6d	W
*Ford	TT	1	380	3¾x4	30x3½n	32x4½n	W
Front Drive...C	1½	2800	3¾x5½	36x6	36x6	W
C.M.C...K16	1	1295	3½x5½	34x5n	34x5n	B
G.M.C...K-41A	2	2375	4 x5½	36x4k	36x7k	W
G.M.C...K-41B	2	2375	4 x5½	36x4k	36x7k	W
G.M.C...K-41T	5†	2450	4 x5½	36x4	36x8	W
G.M.C...K-71A	3½	3600	4½x6	36x5	40x5d	W
G.M.C...K-71B	3½	3700	4½x6	36x5	40x5d	W
G.M.C...K-71T	10†	3700	4½x6	36x5	40x12	W
G.M.C...K-101A	5	3950	4½x6	36x5	40x6d	W
G.M.C...K-101T	15†	4050	4½x6	36x5	40x14	W
G.M.C...K-101B	5	4050	4½x6	36x5	40x6d	W
G.W.W	1½	1850	3¾x5½	35x5	35x5	I
*Garford...15	1	1590	3⅝x5⅛	34x5n	34x5n	W
Garford...25-B	1½	1990	3¾x5⅛	36x3½	36x5	W
Garford...70-H	2½	2750	4¼x5½	36x4	36x8	W
Garford...77-D	4	3750	4½x6	36x5	36x5d	W
Garford...68-D	5	4500	5 x6¼	36x6	40x6d	W
Garford...150-A	7½	5200	5 x6½	36x6	40x7d	C
Gary...F	1–1½	1775	3¾x5	36x3½	36x5	W
Gary...I	2	2450	4 x5½	36x3½	36x6	W
Gary...J	2½	2850	4¼x5½	36x4	36x8	W
Gary...K	3½	3790	4½x6	36x5	40x5d	W
Gary...M	5	4450	5 x6½	36x6	40x6d	W
Gersix...M	1½	3100	4 x5½	36x3½	36x7	W
Gersix...K	2½	3500	4½x5½	36x4	36x8	W
Gersix	3½	4500	4½x6	36x5	40x12	W
Gotfredson...20	1	2075	3¾x5⅛	34x5	34x5	W
Gotfredson...31	1½–2	3000	4 x5¼	36x6	38x7n	W
Gotfredson...A	2½	3375	4 x5¼	36x4	36x7	W
Gotfredson...B	3½–4	4475	4½x5½	36x5	36x10	W
Gotfredson...100	5–6	5500	5 x6½	36x6	40x14	W
Graham Bros	1	1265	3⅞x4½	33x4½n	34x5n	B
Graham Bros	1½	1325	3⅞x4½	33x4½n	36x6n	B
1Gramm-Pion...10	1	1245	3½x5	33x5n	33x5n	B
1Gramm-Pion...15	1½–2	1750a	3¾x5	36x3½k	36x5k	I
1Gramm-Pion...65	1½–2	2250a	3¾x5	36x3½k	36x5	W
1Gramm-Pion...20	2–2½	2475a	4½x5¾	36x4k	36x7k	W
1Gramm-Pion...30	3	3300a	4¼x5½	36x5k	36x5dk	W
1Gramm-Pion.75P	3½	4225a	4½x5½	36x6n	42x9n	W
1Gramm-Pion...40	4	3850a	4½x5½	36x5	36x5dk	W
1Gramm-Pion...50	5–6	4450a	4¾x6	36x6	40x6dk	W
Hall...1½	1½	3100	3¾x5	34x5n	38x7n	W
Hall...2½	2½	3275	4⅛x5¼	36x4	36x6	W
Hall...3½	3½	4100	4½x5½	36x5	36x5d	W
Hall...5	5	5100	4½x5½	36x5	40x6d	W
Hall...7 chain	7	5100	4½x5½	36x5	40x6d	C
Harvey...WOA	2	2650	4¼x5½	34x4	34x7	W
Harvey...WFA	2½	2950	4¼x5½	36x4	36x7	W
Harvey...WHA	3½	3950	4½x6	36x5	36x5d	W
Hawkeye...O	1	1375	3⅝x5⅛	34x5n	34x5n	
Hawkeye...K	1½	1645	3¾x5½	34x3½k	34x5k	I
Hawkeye...M	2	2145	4¼x5	36x4k	36x6k	I
Hawkeye...N	3½	3700	4½x6¾	36x5k	36x10k	I
Hendrickson...O	1½	2200	3⅝x5¼	36x4n	36x5n	W
Hendrickson...N	2½	2690	4¼x5¾	36x4k	36x7k	W
Hendrickson...M	3½	3000	4¼x5	36x5k	36x5dk	W
Hendrickson...K	5	4000	5 x6¼	36x6	40x6	W
Huffman...B	1½–2	1795	3¾x5	34x3½	34x6	W
Huffman...C	1½–2	1695	3¾x5½	36x3½	36x6	I
Huffman...D	2–3	2895	4¼x5½	36x4	36x7	
Hurlburt...A-A	1–1½	1950	3¾x5	34x5n	34x5n	W
Hurlburt...B-B	2–2½	2800	4¼x5½	36x4	36x4d	W
Hurlburt...C-C	3–3½	3475	4¼x5½	36x5	36x5d	W
Hurlburt...D-D	4–4½	4150	4½x6	36x5	36x6d	W
Hurlburt...E-E	6–6½	4850	4¾x6½	36x6	40x6d	W
Indep'd't(Iowa) B	1	1665	3½x5	34x3½	34x4	I
Indep'd't(Iowa) G	1½	2040	3¾x5¼	34x3½	34x5	I
Indep'd't(Ia.)..HI	2½	2940	4¼x5¼	36x4	36x7	I
*Indiana...10	1	....	3¾x5¼	34x5n	34x5n	B
Indiana...12	1½–2	....	3¾x5¼	34x3½k	34x5k	W
Indiana...20	2	....	4½x5½	36x4k	36x7k	W
Indiana...25	2½–3	....	4½x5½	36x4k	36x8k	W
Indiana...35	3½–4	....	4⅝x5¼	36x5k	36x5dk	W
Indiana...51	5–7	....	5 x6¼	36x5k	40x6dk	W
*International...S	1	1250	3½x5	32x4½n	32x4½n	I
International...21	1	1550	3½x5¼	36x3½k	36x3½	I
International...31	1½	1650	3½x5¼	36x3½k	36x5k	I
International...41	2	2100	3½x5¼	36x3½k	36x6k	I
International...52	2½	3500	4¼x5	36x6n	36x6dn	I
International...61	3	2400	4¼x5	36x4k	36x7k	I
International...62	3	2600	4¼x5	36x4	36x7	I
International...101	5	3600	4¾x5	36x5	40x12k	I
International...102	5	3800	4¾x5	36x5	36x12	I
Jackson...4WD	3½	3850	4½x5½	36x7	36x7	B
K-Z...1	1	1750	3½x5	34x3½	34x5	W
K-Z...1½	1½	2075	3¾x5	36x4	36x6	W
K-Z...2½	2½	2550	4⅛x5¼	36x4	36x8	W
K-Z...3½	3½	3350	4½x5½	36x5	40x10	W
K-Z...5	5	3850	4½x5½	36x6	40x6d	W
Kalamazoo...T	1	1295	4 x5	34x5	34x5n	B
Kalamazoo...G-1	1½	1800	3¾x5	34x4	34x5	W
Kalamazoo...LG	2	2645	4 x5	36x4	36x7	W
Kalamazoo...NH	3	3145	4 x6	36x5	36x10	W
Kalamazoo...HD	3	3350	4¼x6	36x5	36x10	W
Kalamazoo...SK	4	3845	4¼x6	36x5	36x12	W
Kalamazoo...OK	5	4350	4½x6	36x6	40x6d	W
2Kelly-S...K-31	1½	2700	3¾x5¼	36x3½	36x6	C
2Kelly-S...K-34	1½	2700	3¾x5¼	36x3½	36x6	W
2Kelly-S...K-38	2½	2900	3¾x5¼	36x4	36x4d	W
2Kelly-S...K-35	2½	2900	3¾x5¼	36x4	36x4d	C
2Kelly-S...K-40	3½	3900	4¼x6½	36x5	40x5d	C
2Kelly-S...K-41	3½	3900	4¼x6½	36x5	36x10	I
2Kelly-S...K-42	3½	3900	4¼x6½	36x5	40x5d	W
2Kelly-S...K-50	5	4400	4½x6½	36x6	40x6d	C
2Kelly-S...K-60	6	4600	4½x6½	36x6	40x7d	C
2Kelly-S...K-61	5–7	4800	4½x6½	36x6	36x7d	I
Kimball...AB	2	3675	4 x6	36x4	36x7	W
Kimball...AC	2½	3975	4½x6	36x4	36x8	W
Kimball...AK	3	4500	4½x6	36x4	36x10	W
Kimball...AE	4	5000	4¾x6	36x5	40x12	W
Kimball...AF	5	5500	5 x6	36x6	40x7d	W
*Kissel...Express	1	1585	3⅞x5½	34x5n	34x5n	W
Kissel...Utility	1½	1975	3⅞x5½	36x3½	36x6	W
Kissel...Freighter	2½	2875	4¼x5½	36x4	36x8	W
Kissel...H. D.	4	3675	4¼x5½	36x5	36x12	W
Kleiber...AA	1	2200	4½x5¼	34x3½k	34x5k	W
Kleiber...A	1½	3100	4½x5¼	36x3½k	36x6k	W

FINAL DRIVE:—B—Bevel, C—Chain, D—Double Reduction, I—Internal Gear, W—Worm.
r—8 cyl. s—6 cyl. t—2 cyl.—all others are 4 cyl.
d—dual tires. k—pneumatic tires optional at extra cost. n—pneumatic tires. a—price includes several items of equipment. b—price includes body. *—express truck or delivery wagon. **—Canadian Make. trac.—tractor. †Capacity with semi-trailer.

1—Gramm-Pioneer. 2—Kelly-Springfield.

Specifications of Current Motor Truck Models—Continued

NAME AND MODEL	Tons Capacity	Chassis Price	Bore and Stroke	TIRES Front	TIRES Rear	Final Drive
Kleiber.....BB	2	$3600	4½x5½	36x1k	36x7k	W
Kleiber.....B	2½	3950	4½x5½	36x5k	36x8	W
Kleiber.....C	3½	4600	4½x5½	36x5	36x5d	W
Kleiber.....D	5	5300	5 x6½	36x6	40x12	W
Koehler.....D	1½	2150	3½x5	34x3½	34x5	W
Koehler.....M	2½	3175	4 x5½	36x4	36x7	W
Koehler.....MCS	2½	3275	4 x5⅝	36x4	36x7	W
Koehler.....F	3½	4470	4½x5½	36x5	36x10	W
Koehler,MT. Trac	5	3275	4 x5⅛	36x4	36x7	W
Krebs.....23	¾	1360	3¾x5	34x4½	34x4½	B
Krebs.....24	1	1675	3¾x5	34x5	34x5	W
Krebs.....45	1½	2275	4½x5½	36x4	36x7	W
Krebs.....75	2½	2550	4½x5½	36x4	36x8	W
Krebs.....110	3½	3175	4½x5½	36x5	40x10	W
Larrabee.....X-2	1	1925	3½x4½	34x5n	34x5n	B
Larrabee.....U	1½	2400	3¾x5	34x3½	34x5	W
Larrabee.....J	1½-2½	2400	3¾x5	34x3½k	34x5k	W
Larrabee.....K	2½-3	3100	4½x5½	36x4	36x7	W
Larrabee.....K-5	2½-3½	3450	4½x5½	36x4	36x8	W
Larrabee.....L-4	3½-5	4000	4½x5½	36x5	36x5d	W
Larrabee.....W	5-7	4800	4¾x6	36x6	40x6d	W
Maccar.....L	1½	....	4½x5½	36x4	36x6	W
Maccar.....H-A	2	....	4½x5¼	36x4	36x4d	W
Maccar.....H-2	3	....	4½x5½	36x4	36x5d	W
Maccar.....M-3	4	....	4½x5½	36x5	36x6d	W
Maccar.....G	5-6	....	4¾x6	36x5	40x6d	W
MacDonald.....A	7½	5750	4½x6	40x7	40x14	I
Mack...AB D.R.	1½	3450	4 x5	36x4k	36x3½dk	D
Mack...AB Chain	1½	3000	4 x5	36x4k	36x3½dk	C
Mack...AB Chain	2	3300	4¼x5	36x4k	36x4dk	C
Mack....AB D.R.	2	3750	4¼x5	36x4k	36x4dk	D
Mack....AB D.R.	2½	3850	4¼x5	36x4k	36x4dk	D
Mack...AB Chain	2½	3400	4¼x5	36x4k	36x4dk	C
Mack...AC Chain	3½	4950	5 x6	36x5k	40x5dk	C
Mack...AC Chain	5	5500	5 x6	36x6	40x6d	C
Mack...AC Chain	6½	5750	5 x6	36x6	40x12	C
Mack...AC Chain	7½	6000	5 x6	36x7	40x7d	C
Mack Trac....AB	5	3400	4¼x5	36x4	36x4d	C
Mack Trac....AC	7	4950	5 x6	36x5	40x5d	C
Mack Trac....AC	10	5500	5 x6	36x6	40x6d	C
Mack Trac....AC	13	5750	5 x6	36x6	40x12	C
Mack Trac....AC	15	6000	5 x6	36x7	40x7d	C
*Mapleleaf.....**	1½	3000	3¾x5½	34x5n	36x6n	W
Mapleleaf...AA**	2	3600	4 x5½	36x4	36x7	W
Mapleleaf...BB**	3	4050	4½x5½	36x4	36x4d	W
Mapleleaf...CC**	4	4800	4½x5½	36x5	36x5d	W
Mapleleaf...DD**	5	5625	4½x5½	36x6	40x6d	W
Master.....JW	1½	2290	3½x5½	34x3½	34x5	W
Master.....JD	1½	2590	4½x5½	34x3½	34x6	D
Master.....Z	2	2290	4½x5½	34x3½	34x5	W
Master.....W	2½	2890	4¼x5½	34x4	36x8	W
Master.....DD	2½	3190	4¼x5½	34x4	36x7	D
Master.....A	3½	3900	4¼x6	36x5	40x8	W
Master.....E	3½	4290	4½x6	36x5	40x5d	D
Master.....Y	4	4490	4½x6	36x5	40x6d	D
Master.....B	5	4990	4¾x6½	36x6	40x6d	W
Master.....F	5	5090	4¾x6½	36x6	40x6d	D
MasterTrac.,DDT	6	3390	4¼x5½	34x4	36x7	D
*Maxwell.....1½	1½	932	3⅝x4½	32x3n	32x4n	W
*Menominee.....	1	1650	4 x5	34x5n	34x5n	W
Menominee....HT	1-1¼	2000	3¾x5	31x3½	36x5	W
Menominee....H	1½	2175	4 x5	36x3½	36x5	W
Menominee....D	2-2½	2875	4 x6	36x4	36x8	W
Menominee....G	3½	3800	4½x6	36x5	36x10	W
Menominee...J-3	5	4250	4¾x6	36x6	40x12	W
Moline.....10	1½	1985	3½x5	34x5n	36x6n	I
[3]Moreland..R. R.	1	1595	4 x5	34x5n	34x5n	B
Moreland.....BX	1½	1980	4 x5	36x3½	36x6k	W
Moreland.....EX	2	2800	4½x5¼	36x4	36x7k	W
Moreland.....AX	3	3500	4½x5½	36x5	36x10k	W
Moreland.....RX	4½-5	4600	4¾x6	36x6	40x6	W
Nash.....2018	1-1½	1595	3¾x5¼	34x4	34x5	I
Nash.....3018	2-2½	2150	3¾x5¼	34x4k	34x7k	I
Nash.....Quad.	2-2½	2750	4¼x5½	36x6	36x5k	I
Nash. 3018, LWB	2-2½	2200	3¾x5¾	34x4k	34x7k	I
Nash. Quad. LWB	2-2½	2800	4¼x5½	36x6	36x6	I
Nash.....5018	2½	2250	3¾x5¼	34x4k	34x7k	I
[4]Nelson.....G2	1½	....	4½x5¼	30x3½	36x6	W
[4]Nelson.....G3	2½	....	4½x5¼	36x4	36x7	W
[4]Nelson.....G4	3½	....	4½x5½	36x5	36x5d	W
[4]Nelson.....G5	5	....	4¾x6	36x6	40x6d	W
Netco.....DK	2	3100	4½x5¼	36x4k	36x7k	W
Netco.....HL	2½	3500	4½x5½	36x4k	36x8k	W
Niles.....E	2	3000	4¼x5½	36x4k	36x7k	W
Noble.....A21	1¼	1750	3¾x5½	34x5	34x5	W
Noble.....B31	1½-2	2395	3¾x5¼	36x4	36x7	W
Noble.....D51	2½-3	2795	4¼x5½	36x4	36x8	W
Noble.....E71	3½-5	3495	4½x6	36x5	36x10	W
Noble.....B30	1½	....	3¾x5¼	36x3½	36x5	W
Noble.....C40	2	....	4 x5½	36x4	36x7	W
Noble.....D50	2½	....	4¼x5½	36x4	36x8	W
Noble.....E70	3½	....	4½x6	36x5	36x10	W
Northwestern..W	1½	2700	4¼x5¼	34x4	36x6	W
Northwestern..WS	2½	3500	4¼x5½	36x4	36x8	W
Norwalk.....25E	1	1595	3½x5	34x3½	34x4	W
Norwalk.....35E	1½	1925	3½x5	34x3½	34x3½d	W
Norwalk,35E.Spec	1½	2285	3¾x5¼	34x3½	34x5	W
Ogden.....A2	1	....	3½x5	34x5n	34x5n	W
Ogden.....D	1½	....	3¾x5	36x3½	36x5	W
Ogden.....E	2½	....	4½x5¼	36x4	36x8	W

NAME AND MODEL	Tons Capacity	Chassis Price	Bore and Stroke	TIRES Front	TIRES Rear	Final Drive
Old Hickory...W	1	$1775	3¾x5	30x3½k	36x4k	W
Old Reliable ...A	1½	2350	4 x5	34x4	36x6	W
Old Reliable ...B	2½	3500	4¼x6	34x4	36x4d	W
Old Reliable....C	3½	4250	4½x6	36x5	36x5d	W
Old Reliable....D	5	5000	4¾x6	36x6	40x6d	W
Old ReliableKLM	7	6000	4¾x6½	36x6	40x7d	C
*Oldsmobile Econ	1	1095	3½x5¼	35x5n	35x5n	I
Olympic.....A	2½	3200	4¼x5½	36x4	36x8	W
Oneida.....B9	1½	2825	4 x5¼	36x3½	36x7	
Oneida.....C9	2½	3700	4 x5¼	36x4	36x8	
Oneida.....D9	3½	4050	4½x5½	36x5	36x10	
Oneida.....E9	5	4725	4¾x5½	36x6	40x12	
Oshkosh.....A	2	2485	3½x5	36x6n	36x6n	B
Oshkosh.....AA	2	2585	3½x5	36x6n	36x6n	B
Oshkosh.....B	2½	3485	4 x5½	38x7n	38x7n	B
Oshkosh.....BB	2½	3585	4 x5½	38x7n	38x7n	B
*Overland.....4	½	425	3⅝x4	30x3½n	30x3½n	B
Packard.....EC	2-3	3100	4½x5½	36x4	36x7	W
Packard.....EX	2-2½	3100	4½x5½	36x6n	40x8n	W
Packard.....ED	3½-4½	4100	4½x5½	36x5	36x5d	W
Packard.....EF	5-7½	4500	5 x5½	36x6	40x6d	W
Paige.....52-19	1½	1950	4 x5¼	34x3½	34x5	W
Paige.....54-20	2½	2420	4¼x5½	34x4	34x8	W
Paige.....51-18	3½	3145	4½x5½	36x5	36x5d	W
Parker.....C-22	1	1875	3¾x5¼	34x5n	34x5n	W
Parker.....G-22	2½	3200	4¼x6	34x4	36x4d	W
Parker.....J-20	3½	3950	4½x6	36x5	40x5d	W
Parker.....M-20	5	4850	5 x6	36x6	40x6d	W
Patriot...Revere	1	1380	3¾x5	35x5n	35x5n	W
Patriot...Lincoln	2	2050	4 x5¼	34x4	34x6	W
Patriot...LS-800	2	2175	4 x5¼			W
Patriot .Washgt'n	3	2900	4½x5½	36x5	36x7	W
Pierce-Arrow....	2	3200	4 x5½	36x4	36x4d	W
Pierce-Arrow....	3½	4350	4½x6¾	36x5	36x5d	W
Pierce-Arrow....	5	4850	4½x6¾	36x5	40x6d	W
Pittsburgher.....	1½-2	3000	3⅝x5	36x4	30x6	..
Pittsburgher.....	3	3800	4½x5¼	36x5k	30x8	W
Power.....F	2	3150	4 x5¼	36x5	30x7	W
Power.....C	3½	....	4½x5½	36x5	40x10	W
Promocar...B-143	1½	2475	3½x5	36x6n	36x6n	W
*Rainier.....R-21	¾	....	3½x5	35x5n	35x5n	W
Rainier.....R-29	1	....	3¾x5	34x3½	34x4	W
Rainier.....R-26	1½	....	3¾x5	34x3½	34x5	W
Rainier.....R-28	2	....	4½x5¼	34x4	34x6	W
Rainier.....R-20	2½-3	....	4½x5¼	34x4	34x7	W
Rainier.....R-15	3½-5	....	4½x5½	36x5	36x5d	W
Rainier.....R25	3½-5	....	4½x5¼	36x5	36x5d	W
Rainier.....R-17	5-6	....	4¾x6	36x6	40x6d	W
Rainier.....R27	6	....	4¾x6	36x6	40x6d	W
Ranger...TK-20-2	1½	1450	3¾x5	36x6n	38x7n	W
*Reo.....F	¾-1½	1185	4½x4½	34x4½n	34x4½n	B
Reliance.....10A	1½	2400	4 x5½	36x3½	36x5	I
Reliance.....20B	2½	3100	4¼x5½	36x4	36x4d	I
Republic.....75	¾	1395b	3¾x5	32x4½n	32x4½n	I
Republic.....10	1	1395	3¾x5	34x3	34x4	I
Republic..10 Exp	1	1695	3¾x5	34x5n	34x5n	I
Republic.....11X	1½	1795	3¾x5	31x4	34x6	I
Republic.....19	2½	2195	4½x5¼	36x4	36x7	I
Republic.....20	3½	3095	4½x5½	36x5	36x10	I
Rowe.....CW	1½	3000	3¾x5	36x6n	36x6n	W
Rowe....C.D.W.	2	3300	4 x5	34x4	36x3½d	W
Rowe....G.S.W.	3	4150	4 x6	34x5	36x5d	W
Rowe....G.P.W.	3	5250	3½x5r	38x7n	42x9n	W
Rowe.....HW	4	4500	4½x6	36x5	36x6d	W
Rowe.....F. W.	5	4850	4½x6	36x6	40x6d	W
Ruggles.....20	1	1195	3¾x5	34x5n	34x5n	B
Ruggles.....40	2	1795	4 x5	34x5n	34x7	D
Samson.....15	¾	....	4-3½x4	32x4n	32x4n	B
Samson.....25	1¼	....	4-3½x5½	35x5n	35x5n	B
Sanford.....W-15	1½-2	2150b	3¾x5	36x3½k	36x5k	..
Sanford.....25	2½-3½	....	4½x5¼	36x4	36x4d	W
Sanford.....35	3½-5	....	4½x5½	36x5	36x5d	W
Sanford.....50	5-7	....	4¾x6	36x5	40x6d	W
Schacht....2-Ton	2	3200	4¼x5½	36x4	36x7	W
Schacht....3-Ton	3	3800	4½x5½	36x5	36x5d	W
Schacht....4-Ton	4	4200	4½x6	36x5	40x5d	W
Schacht....5-Ton	5	4400	4½x6	36x5	40x6d	W
Schacht....7-Ton	7	5050	4½x6	36x6	40x7d	W
Schwartz.....A	1	1685	3½x5	34x4½n	34x4½n	B
Schwartz.....K	2	3000	3¾x5¼	34x3½	34x7	W
Schwartz.....L	3	3600	4¼x5½	36x4	36x8	W
Schwartz.....M	5	4900	4½x6	36x6	40x12	W
Selden.....30	1½-2½	2250	3¾x5	34x3½	34x5	W
Selden.....31	1½-2½	3350	4½x5¼	34x5a	38x7n	W
Selden.....50	2½-3½	3250	4½x5¼	36x4	36x7	W
Selden.....51	2½-3½	4350	4½x5½	36x6n	40x8n	W
Selden.....70	3½-5	3750	4½x5½	36x5	36x10	W
Selden.....90	5-7	4950	4¾x6	36x6	40x12	W

NAME AND MODEL	Tons Capacity	Chassis Price	Bore and Stroke	TIRES Front	TIRES Rear	Final Drive
Seneca.....M	1½	$ 820	3½x4½	30x3½n	30x3½n	B
*Service.....12	¾	....	3½x4½	32x4½n	32x4½n	B
*Service.....25	1½	....	3¾x5½	34x5n	34x5n	B
Service.....21	1½	....	3½x5½	34x3½	34x5	W
Service.....32	2	....	4 x5½	36x3½	36x7	W
Service.....37	2	....	4½x5½	35x5n	38x7n	W
Service.....52	3	....	4½x5½	36x4	36x8	W
Service.....72	3½	....	4½x5½	36x5	36x5d	W
Service.....77	4	....	4½x6	36x5	36x5d	W
Service.....102	6	....	4½x6	36x6	40x6d	W
Signal.....NF	1	1450	3¾x5	34x5n	36x6n	W
Signal.....H	1½	1950	4½x5¼	34x4	36x6	W
Signal.....J	2½	2375	4½x5¼	34x4	36x8	W
Signal.....M	3½	3175	4½x5½	36x5	40x5d	W
Signal.....R	5	3900	4¾x6	36x6	40x6d	W
*Standard.....75	1¼	1330	3¾x5	33x5n	33x5n	W
Standard.....1-K	1½	1600	3¾x5	34x3½k	34x5k	W
Standard.....76	2½-3	2400	4½x5¼	36x4k	36x8	W
Standard.....66	3½-5	3150	4½x5½	36x5	36x12	W
Standard.....5-K	5-7	4400	4¾x6	36x6	40x14	W
*Star.....	½	610b	3½x4¼	30x3½n	30x3½n	B
Sterling.....1½	1½	2885	4 x5¾	36x3½k	36x5k	W
Sterling.....2	2	3085	4 x5¾	36x4k	36x6k	W
Sterling.....2½	2½	3290	4⅜x5¾	36x4k	36x4dk	W
Sterling.....3½	3½	4325	4½x6¼	36x5k	40x5dk	W
Sterling.....5-W	5	4950	5 x6¼	36x6	40x6d	W
Sterling.....5-C	5	5500	5 x6¼	36x6	40x6d	C
Sterling.....7½	7½	6000	5 x6¼	36x6	40x7d	C
*Stewart...Utility	¼-1½	1245	3⅝x5⅛	34x4½n	34x4½n	I
Stewart.....15	1½-1½	1445	3⅝x5⅛	35x5n	35x5n	I
Stewart.....9	1½-2	1790	3¾x5	34x3½	34x6	I
Stewart.....7-X	2½-3	2390	4¼x5½	34x4	34x8	I
Stewart.....10-X	3½-4	3190	4½x6	36x5	36x10	I
*Stewart.....	1¼	1245	4-3½x5	34x4½	34x4½	
*Stoughton.....C	¾	1095	3½x5	34x4½n	34x4½n	B
Stoughton.....A	1	1790	3¾x5¼	34x5n	34x5n	W
Stoughton.....B	1½	2150	3¾x5¼	36x3½	36x5	W
Stoughton.....D	2	2490	4 x5½	36x4	36x7	W
Stoughton.....F	3	3150	4¼x5½	36x5d	36x5d	W
Sullivan.....E	2	2800	4¼x5½	36x4k	36x7k	W
Sullivan.....H	3½	3750	4½x6	36x5	36x5d	W
*Thomart.....	1¼	1795	4 x5¼	34x5	34x5	C
Tiffin.....GW	1½	2100	4½x5¼	36x3½	36x5	W
Tiffin.....MW	2½	2700	4½x5¼	36x4	36x3½d	W
Tiffin.....PW	3½	3600a	4½x5½	36x5	40x5d	W
Tiffin.....PW	5	4300	4¾x6	36x6	40x6d	W
Tiffin.....UW	6	4500	4¾x6	36x6	40x12	W
Titan.....	2	2750	4 x5	36x4k	36x7k	D
Titan.....	2½	2950	4¼x5½	36x4k	36x8k	D
Titan.....	3½	3950	4½x6	36x5k	40x10k	D
Titan.....	5	4550	4½x6	36x5	40x12	D
Tower.....J	1½	2000	4½x5¼	35x5n	38x7n	W
Tower.....H	2½	2475	4½x5¼	36x4	36x7	W
Tower.....G	3½	3475	4½x5½	36x5	36x5d	W
Traffic.....	1½	1595a	3¾x5	35x5n	35x5n	I
Traffic.....C	2	1595a	3¾x5	34x3½k	34x5k	I
Traffic.....	3	1895a	3¾x5	36x4	36x7	I
*Transport.....15	1	1295	3¾x5	32x4½n	32x4½n	B
Transport.....25	1½	1495	3¾x5⅛	34x3½k	34x5k	I
Transport.....35	2	1885a	3¾x5	36x3½k	36x6k	I
Transport.....55	3	2385	4½x5¼	36x4k	36x8k	I
Transport.....60	3½	2585	4¼x5½	36x4k	36x8k	I
Transport.....75	5	3485	4½x6	36x5k	36x12k	I
Traylor.....B	1½	2390	3¾x5½	34x3½	34x5	W
Traylor.....C	2-2½	2850	4 x5½	36x4	36x7	W
Traylor.....D	3-3½	2300	4¼x5½	36x4	36x8k	W
Traylor.....F	5-6	4700	4½x6	36x6	40x6d	W
*Triangle.....AA	1	1285	3¼x5	34x4½n	34x4½n	I
Triangle.....A	1½-2	1985	3¾x5¼	34x3½k	34x6k	I
Triangle.....C	2-2½	2285	3¾x5½	36x4k	36x7k	I
Triangle.....B	2½-3	2585	4 x5¾	36x4k	36x7k	I
Twin City...B.W.	2	2400	4 x5½	36x6	40x8	I
Twin City...AW.	3½	3500	4½x6	36x5	40x5d	W
[5]Twin City.....B	3½	....	5½x6	36x6	36x6	I
[5]Twin City.....A	5	....	5½x6	36x7	36x7	I
Ultimate.....A	2	3150	4 x5½	36x3½	36x6	W
Ultimate.....AJ	2	3200	4½x5½	36x3½	36x6	W
Ultimate.....AJL	2	3250	4½x5½	36x3½	36x6	W
Ultimate.....B	3	3700	4½x5½	36x4	36x4d	W
Ultimate.....BL	3	3800	4½x5½	36x4	36x4d	W
Ultimate.....D	5	5500	5 x6¼	36x6	40x12	W
United.....A	1½	2445	3¾x5¼	36x3½k	34x5k	W
United.....B	2½	3150	4¼x5½	36x4k	36x7k	W
United.....C	3½	3975	4¼x5½	36x5	36x5d	W
United.....V	5	4500	4½x6	36x6	40x6d	W
*United States..U	1¼	1800	3⅝x5½	34x5n	34x5n	B
UnitedStates,NW	1½-2	2375	3¾x5	36x5	36x3½	W
United States...N	1½-2	2175	3¾x5	36x3½k	36x5k	I
United States...R	3	3300	4 x5¼	36x4	36x4d	W
United States...S	4	4075	4½x5½	36x5	36x5d	W
United States...T	5-7	4975	4¾x6½	36x6	40x6d	W
Velie.....46	1½	1585	3¾x5	36x3½k	36x5k	I
Velie.....53	2½	2185	4 x5⅛	36x4k	36x7k	W
Veteran.....M**	1½	2699	3¾x5¼	35x5n	35x5n	W

FINAL DRIVE:—B—Bevel, C—Chain, D—Double Reduction, I—Internal Gear, W—Worm. r—8 cyl. s—6 cyl. t—2 cyl.—all others are 4 cyl. d—dual tires. k—pneumatic tires optional at extra cost. n—pneumatic tires. a—price includes several items of equipment. b—price includes body. *—express truck or delivery wagon. **—Canadian Make. trac.—tractor.

3—Moreland Road Runner. 4—Nelson Le Moon. 5—Twin City Four Wheel Drive.

Specifications of Current Motor Truck Models—Continued

NAME AND MODEL	Tons Capacity	Chassis Price	Bore and Stroke	TIRES Front	TIRES Rear	Final Drive
Veteran.....P**	2	$3699	4¼x5½	36x4	36x7	W
Veteran.....R**	3	4200	4¼x5½	36x4	36x7	W
Veteran.....S**	4	5395	4½x6	36x5	36x10	W
*Vim.....29	1½	1050	3½x4½	31x4n	31x4n	W
*Vim.....50	1½-3¼	995	4 x5	32x4n	32x4n	B
Walker-JohnsonA	2	2500	3¼x5	34x3½	34x6	W
Walker-JohnsonB	3	3000	4¼x5½	36x4	36x8	W
Walter.....M	2½	3850	4½x5⅝	36x4	36x8	D
Walter.....S	5	4850	4½x6½	36x6	40x6d	W
*Watson.....C	1	1465n	3⅝x5½	35x5n	35x5n	W
Watson.....N	3½	4250	4½x5½	36x5	36x10	W
Western....W1½	1½	2450	4½x5½	36x3½k	36x5k	W
Western....L1½	1½	2450	3¾x5	36x3½k	36x5k	W
Western....W2½	2½	3250	4½x5½	36x4	36x7	W
Western....L2½	2½	2450	4¼x6	36x4	36x7	W
Western....W3½	3½	4000	4½x6	36x5	40x5d	W
*White.....15	¾	2400	3¾x5½	34x5n	34x5n	B
White.....20	2	$3250	3¾x5½	36x4k	36x7k	D
Waite.....40	3½	4200	3¾x5¾	36x5	40x5d	D
White.....45	5	4500	4¼x5¾	36x6	40x6d	D
White Hick.....E	1	1225	3¾x5	34x5n	34x5n	W
White Hick....H	1½	1375	3¾x5	36x3½	36x5	W
White Hick....K	2½	1675	4½x5½	36x4	36x5	W
Wichita.....K	1	1875	3¾x5½	36x3½	36x4k	W
Wichita.....M	2	2400	3¾x5¼	36x3½k	36x6k	W
Wichita.....RX	3	3200	4⅜x5¾	36x4k	36x8k	W
Wichita.....O	4	$3500	4½x6¼	36x5k	36x5k	W
Wilcox.....AA	1	1900	3¾x5½	36x4k	36x4k	W
Wilcox.....BB	1½	2550	4¼x5	36x4	36x5	W
Wilcox.....D	2½	3000	4¼x5	36x4k	36x3½dk	W
Wilcox.....E	3½	3950	4½x6	36x5k	36x5dk	W
Wilcox.....F	5	4350	4¾x6½	36x5	40x6d	W
Wilson.....F	1½	2270	3¾x5	36x3½	36x5	W
Wilson.....EA	2½	2825	4½x5½	36x4	36x7	W
Wilson.....G	3½	3685	4½x5½	36x5	36x5	W
Wilson.....H	5	4520	4¾x6	36x6	40x6	W
*Wisconsin.....A	1	1750	3¾x5	34x5n	34x5n	W,B
Wisconsin.....B	1½	2100	3¾x5	35x5	36x6	W
Wisconsin.....C	2½	2700	4 x5¾	36x6n	36x7	W
Wisconsin.....D	3½	3000	4⅜x5¾	36x6n	40x8	W
Wisconsin.....E	5	3500	4½x6¼	36x6	36x10	W
Wisconsin.....F	7	4000	5 x6¼	36x6	36x12	W
Witt-Will.....N	1½	2450	3¾x5	36x3½k	36x6k	W
Witt-Will.....P	2½	2900	4½x5¼	36x4k	36x8k	W

FINAL DRIVE:—B—Bevel, C—Chain, D—Double Reduction, I—Internal Gear, W—Worm.

r—8 cyl. s—6 cyl. t—2 cyl.—all others are 4 cyl. d—dual tires. k—pneumatic tires optional at extra cost. n—pneumatic tires. a—price includes several items of equipment. b—price includes body. *—express truck or delivery wagon. **—Canadian Make. trac—tractor.

Specifications of Current Farm Tractor Models

TRADE NAME	Rating	Price	Wheels or Crawlers	Engine	Cylinders: Bore, Stroke	Fuel	Plow Capacity
Allis-Chal.G.P	6-12	$250	2	LeR.	4-3½x4½	Gas.	1
Allis-Chalm...	15-25	1185	4	Midw.	4-4½x5¼	Gas.	3
Allis-Chalm...	20-35	1885	4	Own	4-4¾x6½	GorK	3-4
‡Allis-Chalm..	20-35	2085	4	Own	4-4¾x6½	G	4
Allwork...2-G	14-28	1595	4	Own	4-4¾x6	GorK	3
Allwork.....C	14-28	1395	4	Own	4-5 x6	GorK	3
¶ARO.1921-22	3-6	385	4	Own	1-4½x5	Gas.	1
Aultman-T....	15-30	1900	4	Clim.	4-5 x6½	G,K,D	4
Aultman-T....	22-45	2800	4	Own	4-5½x8	G,K,D	6
Aultman-T....	30-60	4000	4	Own	4-7 x9	G,K,D	8-10
Automoh. B-3.	12-24	1250	4	Herc.	4-4 x5½	Gas.	2-3
Avery,SR.Cul.	5-10	....	4	Own	4-3 x4	G,K	..
Avery..Cult-C	)...	....	3	Own	6-3 x4	G,K	..
Avery.....B	5-10	....	4	Own	4-3 x4	G,K	2
Avery.....C	....	....	4	Own	6-3 x4	G,K	..
Avery.....	8-16	....	4	Own	2-5½x6	G,K,D	2-3
Avery.....	12-20	....	4	Own	4-4¾x6	G,K,D	2-3
‡Avery.....	....	....	*	Own	4-4x5½	G,K,D	3-4
Avery.....	12-25	....	4	Own	2-6½x7	G,K,D	2-3
Avery.....	14-28	....	4	Own	4-4¾x7	G,K,D	3-4
Avery.....	18-36	....	4	Own	4-5½x6	G,K,D	4-5
Avery.....	25-50	....	4	Own	4-6½x7	G,K,D	5-6
Avery.....	45-65	....	4	Own	4-7¾x8	G,K,D	8-10
Bates Mule.H	15-25	....	4	Midw	4-4½x5¼	Gas.	3
Bates Mule..F	18-25	....	*2	Midw	4-4½x8¼	Gas.	3
‡Bates MuleG	25-35	....	*2	Midw	4-4½x6	Gas.	..
Bear.....	25-35	4250	*2	Ste.	4-4¾x6½	Gas.	4
¶Beeman Jr..	¾-1½	180	2	B&S	1-2½x2½	Gas.	
¶Beeman...G	2-4	240	4	Own	1-3½x4½	Gas.	....
Best.....	30	....	*2	Own	4-4¾x6½	G,K,D	4
Best.....	60	....	*2	Own	4-6½x8½	G,K,D	8-9
¶Bolens	....	....	4	B & S.	1-2½x2¼	G.	..
Boring.....	5-10	395	4	LeR.	4-3½x4½	G	..
Boring...1921	.....	1850	3	Wauk	4-4½x5¾	GorK	2
**Bryan.....	15-30	....	4	Own	2-4 x5	K.	3
Capital.....	15-30	1000	2	Own	4-4¼x6	Gas.	3
Case.....	12-20	1050	4	Own	4-4½x5	G,K,D	2-3
Case.....	15-27	1320	4	Own	4-4½x6	G,K,D	3-4
Case.....	22-40	2550	4	Own	4-5½x6¾	G,K,D	4-5
Case.....	40-72	5200	4	Own	7 x8	G,K,D	8-10
Caterpillar T35	15	....	*2	Own	4-4 x5½	Gas.	3
Caterpillar .5T	25	....	*2	Own	4-4¾x6	Gas.	4
Caterpillar 10T	40	....	*2	Own	4-6½x7	Gas.	6
Centaur.....	5-2½	345	2	N Way	2-4½x4½	GorK	1
Cletrac.....F	9-16	595	*2	Own	4-3¼x4½	G,K,D	2
Cletrac.....W	12-20	1315	*2	Own	4-4 x5½	G,K,D	2-3
Dakota.....4	15-27	1500	3	Dom,	4-4¾x6	Gas.	3
Dill.....D	20	2380	4	Cont.	4-4½x5½	Gas.	3
Dill .....H.W.	20	2980	4	Midw.	4-4½x6	Gas.	3
Do-It-All,Baby	1	237	..	Own	1-2¾x2¾	Gas.	1
Do-It-All.....A	3-6	495	..	Own	1-4½x5	Gas.	1
Do-It-All, Jack	6	395	..	Own	1-3⅜x3¾	Gas.	1
Do-It-All.....6	12	495	2	Own	2-3⅜x3¾	Gas.	1
Eagle.....F	12-22	....	4	Own	2-7 x8	GorK	3-4
Eagle.....H	16-30	....	4	Own	2-8 x8	G or K	4-5
E-B .....AA	12-20	1095	4	Own	4-4¾x5	G,K,D	3
Fageol.....D	9-18	1175	4	Lyc.	4-3½x5	Gas.	2
Farm Horse.B	18-30	1885	4	Clim.	4-5 x6½	G,K	4
Farquhar.....	15-25	....	4	Buda	4-4½x6	G,K,D	3-4
Farquhar.....	18-35	....	4	Own	4-6 x8	G,K,D	4-5
Farquhar.....	25-50	....	4	Own	4-7 x8	G,K,D	6-7
Fitch..4 Drive	20-35	1850	4	Clim.	4-5 x6½	GorK	3-4
Fordson.....	-18	$ 395	4	Own	4-4x5	G.K	2
Frick.....A	12-20	.....	4	Erd.	4-4 x6	G,K	2-3
Frick.....C	15-28	.....	4	Beav.	4-4¾x6	G,K	3-4
Grain Belt,..A	18-36	2150	4	Wauk.	4-4¾x6¾	G or K	4
Gray.....	20-36	1975	3	Wauk.	4-4½x6¼	Gas.	4
Gray.....	22-44	2165	3	Wauk.	4-5 x6¼	Gas.	4-5
Gt. Western St	20-30	1950	4	Beav.	4-4¾x6	K	4
Hart-Parr..20	20	865	4	Own	2-5¼x6½	K,D.	2
Hart-Parr..30	30	1045	4	Own	2-6½x7	K,D.	3
‡Hart-Parr....	....	1335	4	Own	6½x7	K.D.	..
Heider.....D	9-16	628	4	Wauk	4-4¼x5¾	G,K	2
Heider.....C	12-20	725	4	Wauk	4-4½x6¾	G,K	3
Heider ...Cult	5-10	800	4	LeR.	4-3½x4½	Gas.	1
Huber Light 4.	12-25	985	4	Wauk	4-4½x5¾	G or K	3
Huber Super 4	15-30	1885	4	Midw.	4-4½x6	Gas	3
Indiana.....F	5-10	665	2	LeR.	4-3¼x4½	Gas.	1-2
International .	8-16	†670	4	Own	4-4¼x5	G,K,D	2
Internatl.Titan	10-20	†700	4	Own	2-6½x8	G,K,D	3
International..	15-30	1750	4	Own	4-5¼x8	G,K,D	4
¶Kinkade....	1½-3	190	1	Own	1-3 x3	Gas.	....
La Crosse.....	12-24	985	2	Own	2-6 x7	G,K	3
Lauson.....	12-25	1295	4	Midw.	4-4¼x5½	Gas.	3
Lauson.....21	15-30	1675	4	Beav.	4-4¾x6	G or K	3-4
‡Lauson Road	15-30	2000	4	Beav.	4-4¾x6	K	....
Leader.....B	12-18	685	4	Own	2-6 x6¼	G,K,D	2-3
Leader.....N	16-32	1725	4	Clim.	4-5 x6½	G,K	3-4
‡Leader...GU	18-35	2158	*2	Clim.	4-5 x6½	G,K	3-4
Linn.....H4J	40-	4500	*	Cont.	4-4½x5½	Gas	4
Linn.....W	60	5000	*	Wauk	4-5 x6¼	Gas	6
Little Giant,.B	16-22	2200	4	Own	4-4½x5	K	4
Little Giant,.A	26-35	3300	4	Own	1-5½x6	K	6
Lombard.1922	85-150	8950	*2	Wisc.	6-5½x6¾	Gas.	16
Lombard.1922	50	5300	*2	Wisc.	4-4¾x6½	Gas.	6-10
NB.....1	3-6	375	4	Own	2-3¾x4	Gas.	1
Nichols-Shep.	20-42	2650	4	Own	2-8 x10	G or K	3-6
Nichols Shep.	25-50	3000	4	Own	2-9 x12	G or K	4-8
Nichols-Shep.	35-70	3650	4	Own	2-10½x14	G or K	8-12
Nilson Senior..	20-40	1975	5	Wauk	4-5 x6¼	G,K	4
OilPull.....K	12-20	.....	4	Own	2-6 x8	K,D	3
OilPull.....H	16-30	.....	4	Own	2-7 x8½	K,D	4
OilPull.....6	20-40	.....	4	Own	2-8 x10	K,D	5-6
OilPull.....E	30-60	.....	4	Own	2-10x12	K,D	8-10
¶Oldsmar ..K	2½-5	$225	4	Own	1-5½x5½	Gas.	1
Pioneer.....G	18-36	....	4	Own	4-5½x6	G,K,D	4
Pioneer.. ..C	40-75	....	4	Own	4-7 x8	Gas.	10
Plowman....A	15-30	1295	4	Buda	4-4½x6	G,K	3-4
Reliable.....	10-20	390	4	Own	2-6 x7	Ker.	2
Russell.....	12-24	1500	4	Own	4-4¼x5¾	G or K	2-3
Russell.....	15-30	2200	4	Own	4-5 x6½	G or K	3-4
Russell.....	20-35	3000	4	Own	4-5½x7	G or K	4-5
Russell.....	30-60	5000	4	Own	4-8 x10	G or K	8-10
Samson....M	....	445	4	Own	4-4 x5½	G,K	2
Sandusky,...J	10-20	1250	4	Own	4-4¼x5¾	G,K,D	2
Sandusky...E	15-35	1750	4	Own	4-5 x6½	G,K,D	4
¶Shelby.....	1	150	3	B & S	1-2½x2½	G	..
Shelby.....D	15-30	....	4	Beav.	4-4¾x6	G,K	3
Shelby.....C	9-18	....	4	Wauk	4-3¾x5¼	G or K	2
Toro Cultivator	6	750	3	LeR	4-3½x4½	Gas.	2
ToroTractor'22	6-10	495	3	LeR	4-3½x4½	Gas.	2
Townsend....	10-20	800	2	Own	4-6½x7	Ker.	2-3
Townsend....	15-30	1350	2	Own	4-7 x8	Ker.	3-4
Townsend....	25-50	2500	2	Own	4-8½x10	Ker.	4-8
Traction Motor	40-50	....	4	....	8-3½x5	Gas.	4-5
Traylor....TB	6-12	500	4	LeR.	4-3½x4½	Gas.	1-2
Trundaar...10	25-40	3750	*2	Wauk	4-5 x6¼	G or K	4
Twin City....	12-20	1200	4	Own	4-4¼x6	G,K	3
Twin City....	20-35	2750	4	Own	4-5½x6¾	G,K	5-6
Twin City....	40-65	4750	4	Own	4-7¾x9	G,K	8-10
Uncle Sam C20	12-20	1295	4	Weid.	4-4 x5½	G	2-3
Uncle Sam B19	20-30	1985	4	Beav.	4-4¾x6	G or K	3-4
Uncle Sam D21	20-30	1895	4	Beav.	4-4¾x6	G or K	3-4
Utilitor....501	2¼-4	295	4	Own	1-3½x4½	G	1
Utilitor...501A	2¼-4	340	4	Own	1-3½x4½	G	1
Wallis.....K	15-25	....	4	Own	4-4¼x5¾	G,K	3
Waterloo....N	12-25	675	4	Own	2-6½x7	Ker.	3
Wetmore 21-22	12-25	1185	4	Wauk	4-4 x5¾	G,K	3
Whitney....D	9-18	595	4	Own	2-5½x6½	Gas.	2
Wichita.....T	15-30	2000	4	Beav.	4-4½x6	G,K,D	3-4
Wisconsin...E	16-30	1850	4	Clim.	4-5 x6½	G or K	3
Wisconsin...F	20-40	2050	4	Wauk	4-5 x6¼	G or K	4
Wisconsin...H	22-40	2550	4	Clim.	4-5½x7	G or K	4-6
Yuba....12-20	12-20	2400	*2	Wauk.	4-4½x6¾	G,K,D	3
Yuba....15-25	15-25	2750	*2	Wisc.	4-4½x6	G,K,D	..
Yuba....20-35	20-35	3900	*2	Wisc.	4-5¾x7	G,K,D	4
Yuba....25-40	25-40	4250	*2	Wisc.	4-5¾x7	G,K,D	..
‡Yuba.....	25-40	4750	*2	Yuba	4-5½x7	D	..

ABBREVIATIONS: G—Gasoline. K—Kerosene. D—Distillate. Plow capacity varies in relation to operating conditions. Figures are based on 14 in. plows. Engine Make: Beav.—Beaver. B & S—Briggs & Stratton. Clim.—Climax. Cont.—Continental. Dom.—Domas Evin.—Evinrude. Herc.—Hercules. LeR.—LeRoy. Midw.—Midwest. Nway.—New Way. Nor.—Northway. Ste.—Stearns. Wauk.—Waukesha. Weid.—Weidely. Wis.—Wisconsin. *—Crawler type. All others are wheel type. †Price includes plows. §Track Runner. ‡Industrial Tractor. ¶Garden Tractor. **Steam Tractor

Specifications of Current Passenger Car Models

PRICES 2-Pass.	5-Pass.	7-Pass.	Sport	Coupe	Sedan	Wheel Base	Tires	Engine Make	Cylinders: Bore and Stroke	Rated Horse Power (S.A.E.)	NAME AND MODEL	Carburetor	Starting and Lighting	Ignition	Clutch: Type and Make	Gearset	Universal: Type and Make	Rear Axle Type and Make	†Gear Ratios
.....	$4500c	$4500	.....	.....	$6500	136	33x5	Cont..	6-3⅝x5¼	31.54	Ambassador.....R	Strom...	West.....	Bosch.....	m-d B-L....	B-L....	f Norwalk..	F Tim...	4.45
$1995c	1785	1850	$1885c	.....	2485	127	33x4½	H-S...	6-3½x5	29.40	American.....D-66	Strom...	G-D.....	A-K.....	s-p B&B...	B & B..	m Hartford..	F Salis..	4.50
.....	1195	.....	.....	$1450c	.....	114	32x4	Cont..	6-3⅛x4¼	23.44	Anderson...Aluminum 6	.....	West.....	West.....	s-p B&B...	.....	.....	Salis..	.....
{1495	1495	1595	{1595c	1995c	1995d	120	33x4	Cont..	6-3⅜x4½	27.34	Anderson.....Series 40	Rayfield.	Remy.....	Remy.....	s-p B&B...	Durst...	f Snead.....	¾F Salis..	4.50
{1785p	.....	.....	{1945c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	2620	2645	.....	3625	3695	130	34x4½	Own..	8-3½x5	33.80	Apperson.....8-21-S	Johnson.	Bijur.....	Remy.....	m-d Own....	Own....	m Sterl.....	½F Own..	4.25
1575	1475	1545n	{1895n	2275	2345	121	32x4	Cont..	6-3⅜x4½	27.34	Auburn.....6-51	Strom...	Remy.....	Remy.....	s-p B&B....	G-L.....	m Univers...	F Salis..	4.75
.....	1395	.....	{1995n	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1800	1800	.....	.....	.....	1850d	118	32x4	Cont..	6-3½x4¼	23.44	Barley.....	.....	Delco.....	Delco.....	s-p B&B ...	Fuller...	f M&E.....	Col.....	.....
2950	2950c	.....	.....	2400	2500	121	32x4	Cont..	6-3¼x4½	25.35	Bay State.....	Strom...	Delco.....	Delco.....	s-p B&B...	Warner..	m Spicer....	¾F Col...	4.67
5000	5000	.....	.....	3950	3950	121	32x4	Buda..	4-3¾x5½	22.50	Biddle.....B1 & B5	Zenith...	G-D.....	Simms.....	s-p Warner .	Warner..	m Spicer....	½F Std...	4.50
865	885	725g	.....	1175	{1395	109	31x4	Own..	4-4 x5½	25.60	Brewster.....91	Zenith...	U&L.....	Bosch.....	c Own....	Own....	F Own.....	F Own..	3.92
1175	1195	975g	.....	1935	{1325	118	33x4	Own..	4-4¾x4¾	18.23	Buick..1923-34-5-6-7-38	Marvel..	Delco.....	Delco.....	m-d Own....	Own....	m Own.....	¾F Own..	4.66
.....	.....	1435	{1625a	1895	2195	124	34x4½	Own..	6-3⅜x4½	27.34	Buick....1923-41-4-5-47	Marvel..	Delco.....	Delco.....	m-d Own....	Own....	m Own.....	¾F Own..	4.60
3100	3150	3150	{1675c	.....	{3875a	4100	132	33x5	Own..	8-3½x5½	31.25	Buick.1923-48-9-50-4-55	Marvel..	Delco.....	Delco.....	m-d Own....	Own....	m Own.....	¾F Own..	4.90
.....	.....	.....	.....	.....	{3925d	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1750	1790	.....	.....	2480	2575	122	32x4½	Cont..	6-3⅜x4½	27.34	Cadillac.....61	Own....	Delco.....	Delco.....	m-d Own....	Own....	m Spicer....	F Tim...	4.50
.....	1990	2250	1950	2480	2575	122	32x4½	Cont..	6-3⅜x4½	27.34	.....	.....	.....	.....	.....	.....	.....	.....	.....
1185	1185	.....	.....	1595	2295	129	34x4½	Cont..	6-3⅝x5¼	31.54	Case.....X	Rayfield.	Delco.....	Delco.....	m-d Own....	Own....	f Snead.....	7/12F Col..	5.25
.....	.....	1345	.....	.....	.....	117	32x4	Own..	6-3¼x4½	25.35	Case.....W	Rayfield.	Delco.....	Delco.....	m-d Own....	Own....	f Snead.....	¾F Col...	4.45
1495	1495c	1645	1595a	1995c	{2295d	122	32x4	Own..	6-3¼x4½	25.35	Chalmers.....1922	Strom...	A-L.....	Remy.....	m-d Own....	Own....	m Arvac.....	½F Adams	5.13
.....	.....	.....	.....	.....	{2375f	123	33x4	Own..	6-3½x5	29.40	Chalmers.....1922	Strom...	A-L.....	Remy.....	m-d Own....	Own....	m Hardy.....	½F Adams	5.13
510	525	425g	.....	{840c	860	102	30x3½	Own..	4-3¹¹/₁₆x4	21.53	Chandler.....Six	Rayfield.	Bosch.....	Bosch.....	s-p B&B....	Own....	m Hardy.....	½F Adams	5.13
.....	.....	.....	.....	{680k	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	f Own.....	F Own..	4.45
1085	1095	.....	1260	1495	1585	112	32x4	Own..	6-3⅛x4½	27.34	Chevrolet.....Superior	Zenith...	A-L.....	Remy.....	c Own....	Own....	m Own.....	½F Own..	3.66
2685	.....	2685	2685c	3285b	{3285c	127¼	33x5	Nort..	8-3½x4½	39.20	Cleveland.....41	Strom...	Bosch.....	Bosch.....	s-p Own....	Own....	m Mech.....	¾F Own..	4.45
.....	.....	.....	.....	.....	{3685f	.....	.....	.....	.....	.....	Cole.....890	Johnson.	Delco.....	Delco.....	c North....	North...	m Spicer....	F Col...	4.46
1475	1475	.....	1475c	1925c	1995d	115	32x4	Cont..	6-3⅜x4½	27.34	.....	.....	.....	.....	.....	.....	.....	.....	.....
995	985	.....	.....	.....	1395d	115	31x4	Cont..	6-3½x4¼	23.44	Columbia.....Elite	Strom...	A-L.....	A-K.....	s-p B&B....	Durst...	m Spicer....	¾F Tim...	.....
.....	1985	3085f	.....	2985d	3085f	125	33x4½	Cont..	6-3½x5¼	29.40	Columbia.....Light Six	Strom...	A-L.....	A-L.....	s-p B&B....	Durst...	m Spicer....	¾F Tim...	.....
1395	1395	.....	{1495b	2065b	2165d	116	32x4	Falls.	6-3¼x4¼	23.44	Comet.....C-53	Strom...	Wagner....	Wagner....	s-p B&B....	Muncie..	m Arvac.....	¾F Col...	4.45
.....	.....	.....	{1495	.....	.....	.....	.....	.....	.....	.....	Courier.....	Till.....	Bijur.....	A-K.....	s-p B&B....	Muncie..	f Norwalk..	¾F Col...	5.00
3000	3000	3000	.....	.....	4500	122½	32x4	Cont..	6-3⅝x5¼	31.54	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	3500	.....	.....	135	33x5	Cont..	6-3⅝x5¼	31.54	Crawford.....22-6-60	Strom...	West.....	Bosch.....	m-d B-L....	B-L.....	Spicer....	½F Tim...	.....
4350b	4350c	4350	.....	5250	6000	142	33x5	Own..	8-3¾x5	45.00	Crawford-Dagmar...6-60	Zenith...	West.....	Bosch.....	m-d B-L....	B-L.....	Spicer....	½F Tim...	.....
.....	1295	.....	1495	1795	1795	132	33x5	Own..	8-3½x5½	39.20	Cunningham.....V	Strom...	Delco.....	Delco.....	m-d Own....	Own....	f Snead.....	F Tim...	4.23
1595	1595	.....	1695	2035	.....	114	31x4	Cont..	6-3½x4¼	23.44	Daniels.....D-19	Zenith...	Delco.....	Delco.....	m-d Own....	Own....	m Spicer....	F Tim...	.....
1175	1175	1295c	1245	1545	1595	120	32x4	Cont..	6-3⅜x4½	27.34	Davis.....71	Strom...	Delco.....	Delco.....	s-p B&B....	Warner..	m Peters....	½F Tim...	5.10
850	880	.....	.....	980h	1195d	112	32x4	H-S..	4-3½x5	19.60	Davis.....61-67	Strom...	Delco.....	Delco.....	s-p B&B....	Warner..	m Peters....	¾F Tim...	5.15
3350g	3950c	3950	.....	4985c	5750f	114	32x4	Own..	4-3⅞x4½	24.03	Dixie Flyer.....H-S-70	Strom...	Dyneto....	Eise.....	s-p B&B....	Warner..	m Peters....	¾F Tim...	5.15
865	865	.....	{1015a	{1240	{1370	132	33x5	Own..	6-4 x5	38.40	Dodge Brothers.....	Stewart..	N.E.....	N.E.....	m-d Own....	G-L.....	f Hardy.....	F Peru..	4.75
.....	.....	.....	{1015d	{1020c	{1070k	108	31x4	D-Ly.	4-3½x5	19.60	Dorris.....6-80	Strom...	West.....	Bosch.....	m-d Own....	Own....	m Own.....	½F Own..	4.16
1275	1275	.....	.....	1650	1975	104	30x3½	Own..	4-2⅝x4½	11.03	Dort.....19-14	Carter...	Bosch.....	Conn.....	m-d Det....	Own....	m Spicer....	F Tim...	4.23
6500	6500	6750	.....	7800	7800	134	33x5	Own..	8-27/8x5	26.45	.....	.....	.....	.....	.....	.....	m Mech.....	¾F Flint..	4.66
3000	3200	.....	.....	3800	4000	124	32x4½	Own..	4-3⅛x5½	24.81	Driggs.....	Zenith...	Bosch.....	Bosch.....	s-p Hoos..	Mech....	m Spicer....	¾F Own..	4.75
890	890	.....	.....	1365	1365	109	31x4	Cont..	4-3⅞x4¼	24.03	Du Pont.....A	Strom...	Delco.....	Delco.....	s-p Own....	Own....	f Own.....	½F Own..	4.81
1600	1650	.....	.....	2250	2100	123½	32x4½	Anst..	6-3¼x4½	25.35	Durant.....A-22	Y&T.....	West.....	Eise.....	m-d B-L....	B-L.....	m Spicer....	Col.....	4.50
1485	1095	950g	.....	1395c	1795	112	32x4	Own..	4-3⅞x5¼	18.91	Durant.....B-22	Till.....	A-L.....	A-L.....	s-p Own....	Own....	m,f Spicer..	¾F Adams	4.30
1095	1095	.....	1095	1345	.....	118	33x4	Lyc..	4-3½x5	19.60	Earl.....40	Rayfield.	A-L.....	A-L.....	s-p Anst....	Warner..	m,f Spicer..	½F Tim...	5.15
1395	1395	.....	1395	1975	2065	118	33x4	Cont..	6-3⅜x4½	27.34	Elcar.....K-4	Scoe....	A-L.....	Conn.....	s-p B&B....	Own....	f Own.....	½F Own..	3.66
1125c	1125	.....	1165	1695	1615	118	33x4	Falls..	6-3⅛x4¼	23.44	Elcar.....7-R	Strom...	Delco.....	Delco.....	s-p B&B....	Muncie..	m Peters....	¾F Salis..	4.50
.....	1045	.....	.....	1145k	1895	108½	32x4	Own..	4-3⅝x5	18.23	Elgin.....K-1	Strom...	West.....	Wagner....	m-d Warner .	Warner..	m Spicer....	¾F Salis..	4.50
269r	298s	235g	.....	530	{1245k	.....	.....	.....	.....	.....	Essex.....	Own....	Bosch.....	Bosch.....	s-p B&B....	Mech....	m Mech.....	¾F Col...	4.66
.....	.....	.....	.....	.....	{595	100	30x3½	Own..	4-3¾x4	22.50	.....	.....	.....	.....	m-d Own....	Own....	m Spicer....	½F Own..	4.66
3900	3900	.....	.....	4900	{725	132	32x4½	Own..	6-3⅝x5	27.34	Ford.....T	Own....	Own.....	Own.....	.....	.....	.....	.....	.....
1900	1950	1750g	.....	2750	4900	115	32x4	Own..	6-3¼x4	25.35	.....	.....	.....	.....	m-d Own....	Own....	m Own.....	½F Own..	3.63
895	895	.....	.....	1095k	2850	112	32x4	Lyc..	4-3½x5	29.60	Fox.....7F	Zenith...	West.....	Bosch.....	m-d B-L....	B-L.....	Spicer....	½F Tim...	4.45
1385	1385	.....	.....	1895	1345d	116	32x4	Own..	6-3½x4½	23.44	Franklin.....10	Own....	N.E.....	A-K.....	s-p B&B....	Own....	m Spicer....	½F Own..	4.73
490	490	.....	.....	.....	1945	100	30x3½	Own..	4-3⅝x4	21.03	.....	.....	.....	.....	.....	.....	.....	.....	.....
2475	2475c	.....	3250	.....	760	120	32x4½	Weid..	4-3¾x5½	22.59	Gardner.....T-R & G	Carter...	West.....	West.....	s-p B&B....	Mech....	m Mech.....	¾F Flint..	4.80
.....	.....	2650	.....	3450	3475	125	32x4½	Own..	4-4½x5½	27.23	Grant.....	Strom...	Bijur.....	A-K.....	s-p B&B....	Durst...	m Spicer....	¾F Col...	4.66
.....	995	.....	.....	.....	3450	114	31x4	Cont..	6-3½x4¼	27.23	Gray.....	Scoe....	West.....	West.....	m-d Own....	Detr....	m Mech.....	½F Tim...	3.90
1595	1595	1795	.....	2475c	2585	121	32x4	Cont..	6-3½x4¼	25.35	H.C.S.....Series 4	Strom...	Delco.....	Delco.....	m-d B-L....	B-L.....	m Spicer....	¾F Own..	.....
.....	1345	1345c	.....	1950	1950	115	32x4	H-S..	4-3½x5	19.60	Handley-Knight.....	Till.....	A-L.....	A-L.....	m-d Warner .	Warner..	m Spicer....	¾F Tim...	4.90
2395	2395c	2395	.....	3095d	3395	132	33x5	Own..	6-3⅜x4½	27.31	Hanson.....30	Marvel..	Delco.....	Delco.....	s-p B&B....	Detr....	.....	¾F Tim...	.....
1515	1495	.....	{1895a	{2030b	{2395d	121	32x4	H-S..	4-3½x5	19.60	Hanson.....60	Marvel..	Delco.....	Delco.....	s-p B&B....	Detr....	.....	¾F Tim...	.....
.....	.....	.....	{1895d	{2135p	{2695p	.....	33x5	Own..	6-3½x5⅛	29.40	Hatfield.....A-42	Zenith...	Dyneto....	Conn.....	s-p B&B....	G-L.....	m Spicer....	¾F Tim...	.....
.....	2500c	2500	.....	3300c	3600f	126	34x4½	Own..	6-3½x4¼	29.40	Haynes.....75	Strom...	L-N.....	King.....	s-p Warner .	Own....	m Univers..	¾F Col...	4.66
.....	1525c	1575	.....	2570c	1675k	126	34x4½	Own..	6-3½x5	29.40	Haynes.....55	Rayfield.	L-N.....	King.....	s-p Warner .	Own....	m Univers..	¾F Own..	4.60
1395	1395	.....	.....	.....	{2295	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	½F Own..	4.11
1150	1150	.....	1025g	{1635	2295	120	32x4	Cont..	6-3⅜x4½	27 34	Holmes.....Series 4	Strom...	Dyneto....	Eise.....	m-d B-L....	B-L.....	m Spicer....	½F Tim...	4.90
.....	.....	.....	.....	{1335k	1785	112	32x4	Own..	4-3¼x5½	16.90	Hudson.....Super 6	Own....	Bosch.....	Bosch.....	m-d Own....	Own....	m Spicer....	½F Own..	4.90
.....	1485	1685c	.....	2085	2085	121	32x4½	Cont..	6-3¼x4½	25.35	Huffman.....	Strom...	Dyneto....	Conn.....	s-p B&B....	Covert....	.....	.....	4.45
995b	995	.....	1095a	1445c	1465d	112	31x4	Own..	6-3¼x5	25.35	Hupmobile.....Series R	Strom...	West.....	A-K.....	m-d Own....	Own....	m Univers..	F Salis..	.....
1895	1795	.....	.....	2785	2485	120	32x4	Own..	6-3½x4¾	26.38	.....	.....	.....	.....	.....	.....	.....	¾F Own..	4.87
.....	.....	2150c	.....	.....	.....	124	32x4	Own..	6-3½x4¾	26.38	Jackson.....638	Strom...	A-L.....	Remy.....	s-p B&B....	Cov.....	f Snead.....	¾F Salis..	4.75
.....	985	.....	.....	.....	1450	111	32x31/2	Gray..	4-3½x5	19.60	Jewett.....Six	Strom...	Remy.....	A-K.....	m-d Long....	Warner..	m Mech.....	½F Tim...	4.45
.....	985	.....	.....	.....	2175	118	32x31/2	Gray..	4-3½x5	19.60	Jordan.....MX	Strom...	Delco.....	Delco.....	s-p Detr....	Detr....	m Spicer....	½F Tim...	4.42
.....	1525	.....	.....	.....	1450	111	32x31/2	Gray..	4-3½x5	19.60	Jordan.....H	Strom...	Delco.....	Delco.....	s-p Detr....	Detr....	m Univers..	½F Tim...	4.42
5000	5000	5250	.....	.....	6000	130	32x4	Walk'r	6-3½x4½	23.44	Kelsey.....4	Scoe....	Bosch.....	Bosch.....	f-d Own....	f-d Own..	.....	Own.....	4.50
1795	1795	.....	1795c	2400	2550	120	32x4½	Own..	8-3 x5¼	28.80	Kelsey.....4	Scoe....	Bosch.....	Bosch.....	s-p B&B....	Detr....	Snead.....	½F Std...	4.75
.....	1885	2385	2385c	2975c	3075	124	32x4½	Own..	8-3 x5	28.80	Kelsey.....6	Strom...	Bijur.....	Bosch.....	f-d Own....	f-d Own..	.....	Own.....	.....
1690	1690	1690	1890	2750	2890	121	33x4	Cont..	6-3⅝x4½	27.34	Konworthy.....8-90	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	King.....K	Ball&B	West.....	A-K.....	s-p Detr....	Own....	f Hardy.....	F Col...	4.08
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Kissel.....45	Strom...	Remy.....	Remy.....	m-d Warner	Warner..	m Spicer....	F Own..	3.92
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Kline Kar.....6-55-K	Rayfield.	Wagner....	Conn.....	s-p B&B....	G-L.....	f Snead.....	½F Std..	4.75

MISCELLANEOUS

a—2 Passenger,
b—3 Passenger,
c—4 Passenger,
d—5 Passenger,
e—6 Passenger,
f—7 Passenger,
g—Chassis Price,
h—All Metal Type,
k—Soft Top Type,
n—Tire Size 32x4½,
p—Sport,
r—Price without starter and demountable rims. Price, complete, $364.
s—Price without starter and demountable rims. Price, complete, $393.
†Standard Phaetons.

(Continued on page 106)

ENGINE

Anst—Ansted
Bea—Beaver
Cont—Continental
Curt—Curtiss
D.-Ly—Dort Lycoming
G-B—Grey Beal
H-S—Herschell-Spillman
Lyc-Lycoming
Nort—Northway
Roch—Rochester
Rut-Rutenberg
Supr—Supreme
Walk'r—Walker
Weid—Weidely
Wisc—Wisconsin

CARBURETOR

Ball & B—Ball & Ball
Till—Tillotson
Strom—Stromberg

GEARSET

f-d—Friction Drive
B-L—Brown-Lipe
Cov—Covert
Detr—Detroit
Durst—Durston
G-L—Grant-Lees
Hoos—Hoosier
Mech—Mechanics
North—Northway

CLUTCH

f-d—Friction drive
c—Cone
m-d—Multiple disc
s-p—Single plate
Anst—Ansted
B & B—Borg & Beck
B-L—Brown-Lipe
Det—Detlaff
Detr.—Detroit

STARTING, LIGHTING IGNITION

A-L—Auto Lite
Bring—Berling
G-D—Gray & Davis
L-N—Leece Neville
N. E.—North East
West—Westinghouse

UNIVERSAL

f—fabric
m—metal
M &E—Merchant & Evans
Mech—Mechanics
Sterl—Sterling
Univers—Universal

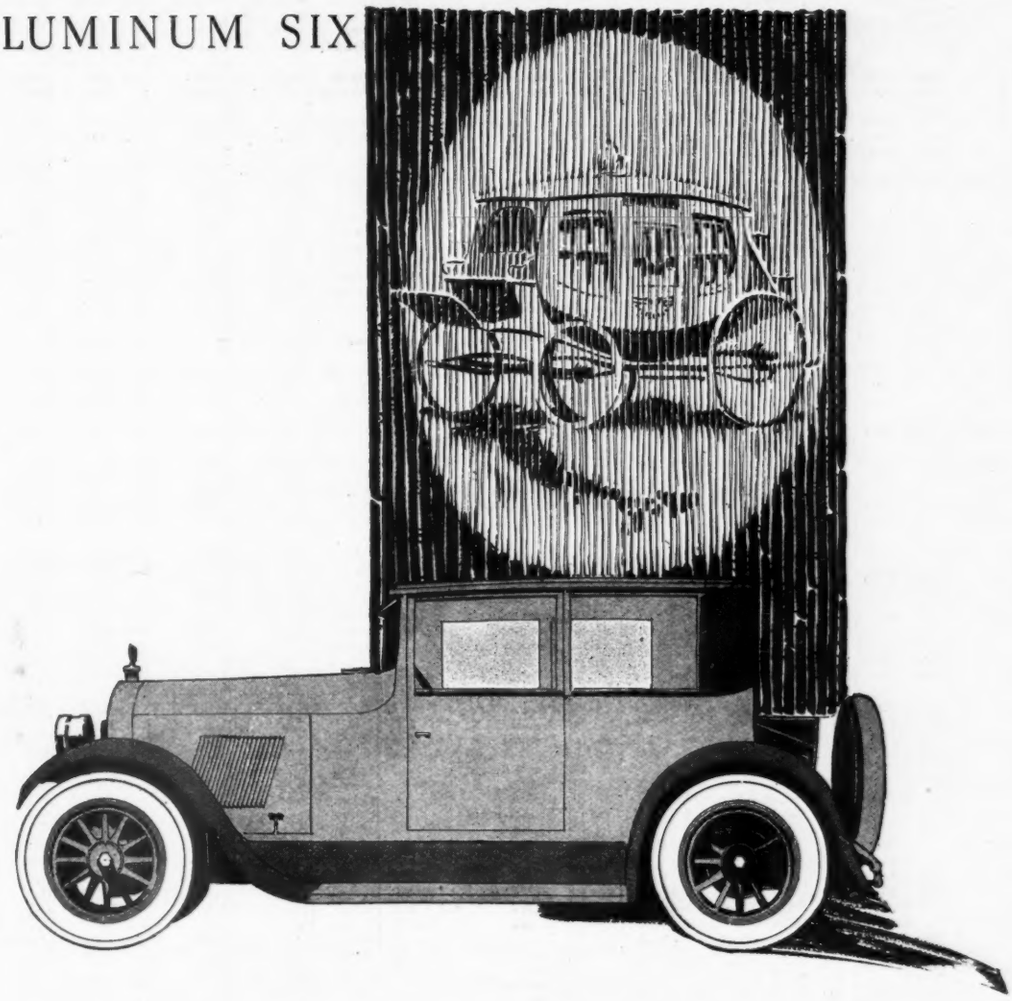
REAR AXLE

F—Floating
½ F—Semi-Floating
¾ F—Three-Quarter Floating
Col—Columbia
Salis—Salisbury
Std—Standard
W-M—Weston-Mott
Tim—Timken

The Coachbilt

ANDERSON

ALUMINUM SIX



Equipped with everything, even to a patented foot dimmer for headlights.

SPECIFICATIONS:

Coachbilt Anderson Aluminum Body; 6 Cylinder Red Seal Continental Motor; Westinghouse Starting, Lighting, Ignition; Borg and Beck Clutch; Cord Tires; Alemite Lubrication; Snubbers; Motometer; Wind Shield Cleaner; Patented Foot Dimmer for Headlights. Wheelbase 115 inches. Averages 19 Miles per Gallon of Gas.

Coach

$1450

Touring Car $1195

f. o. b. factory

Anderson Motor Company, Rock Hill, South Carolina

Specifications of Current Passenger Car Models

PRICES 2-Pass.	5-Pass.	7-Pass.	Sport	Coupe	Sedan	Wheel Base	Tires	Engine Make	Cylinders: Bore and Stroke	Rated Horse Power (S.A.E.)	NAME AND MODEL	Carburetor	Starting and Lighting	Ignition	Clutch: Type and Make	Gearset	Universal: Type and Make	Rear Axle: Type and Make	†Gear Ratio
$3985	$4090c	$4090	.....	$5500	$5500	132	33x5	Own..	8-3¼x5½	33.80	LaFayette	Johnson	Delco	Delco	m-d	Own	Own	m	F	4.58
5500	5500	5500	.....	5500	5500	134	32x4½	Own..	6-3⅜x5¼	33.75	Leach 999	Rayfield	Delco	Delco	m-d	.....	Own	m,f	Tim	.....
1695	1695	1795	$2045d	2345c	2515d	123	32x4½	Anst..	6-3¼x4½	25.35	Lexington 23	Rayfield	G-D	Conn	m-d	Anst	Warner	f	Snead	3¾F	5.10
	1995	2095			2145d																
1575	1395	.....	1575	2085	2245	117	32x4	Own..	6-3½x5	23.44	Liberty 10-D	Strom	Wagner	Wagner	s-p	B&B	Detr	m	Spicer	½F	Tim	4.80
				1695k																	
3800	3800c	3800	.....	4400d	4700d	136	33x5	Own..	8-3⅜x5	36.45	Lincoln	Strom	Delco	Delco	m-d	Own	Own	m	Spicer	F	Tim	4.58
.....	7600c	7600	.....	10500	11000	142	35x5	Own..	6-4½x5½	48.60	Locomobile 48	Ball&B	West	Delco	m-d	Own	Own	m	Own	F	Own	3.50
3385	3185c	3185	.....	3985	4385	136	32x4½	Own..	6-3⅜x5⅛	33.75	Marmon 34	Strom	Delco	Delco	m-d	Own	Own	m	Spicer	¾F	Own	3.75
885	885	.....	.....	985	1335	109	31x4	Own..	4-3⅝x4½	21.03	Maxwell	Stewart	A-L	Simms	c	Own	Own			¾F	Own	4.56
				1235																	
6300	6300c	6300	.....	7500	7500	140	33x5	Own..	6-4½x6	48.60	McFarlan 1922	Rayfield	West	Split	s-p	B&B	B-L	m	Peters	F	Tim	3.80
3950	3950c	3950c	.....	4850	5250	132	32x4½	Own..	4-3⅝x6¾	22.50	Mercer Series 5	Ball&B	West	Eise	m-d	Own	Own	m	Spicer	F	Own	3.87
.....	3750	3750	.....	5000	5000	132	32x4½	Own..	6-3⅜x5	33.75	Mercer 6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1895	1895	.....	.....	.....	.....	119	32x4	Cont..	6-3¼x4½	25.35	Merit	Strom	Delco	Delco	s-p	B&B	Muncie	f	Snead	F	Col	4.60
1490b	1590	.....	1850c	2050c	2275d	120	32x4	Own..	6-3½x5	29.40	Mitchell F-50	Strom	Remy	Remy	s-p	B&B	Own	m	Own	F	Own	4.42
.....	.....	1690	.....	.....	.....	127	32x4½	Own..	6-3½x5	29.40	Mitchell F-50	Strom	Remy	Remy	s-p	B&B	Own	m	Own	F	Own	4.42
950	950	.....	.....	.....	.....	115	32x4½	Own..	4-3¼x4½	16.90	Monroe 1922-S-9	Zenith	A-L	Conn	m-d	Own	Mech	m	Univers	¾F	Own	5.30
1295	1195	p1445d	1885c	1585c	1695	115	31x4	Cont..	6-3¼x4½	23.44	Moon 6-40	Strom	Delco	Delco	s-p	B&B	Warner	m	Spicer	½F	Tim	4.80
1785	1785	1785	1885	2785	2785f	128	33x4½	Cont..	6-3⅝x4½	27.34	Moon 6-58	Strom	Delco	Delco		B&B	B-L	m	Spicer	½F	Tim	5.09
					2485c																
1210	1240	.....	1395c	.....	2040d	121	33x4	Own..	6-3¼x5	25.35	Nash 691-96-97	Marvel	Delco	Delco	s-p	B&B	Own	m	Own	½F	Own	4.50
.....	.....	1390	1645	1890c	2190f	127	34x4½	Own..	6-3¼x5	25.35	Nash 692-94-95	Marvel	Delco	Delco	s-p	B&B	Own	m	Own	½F	Own	4.50
915	935	.....	.....	1385b	1545d	112	33x4	Own..	4-3⅜x5	18.23	Nash Four 41-4	Schebler	Delco	Delco	s-p	B&B	Own	m	Own	½F	Own	4.88
				1195k	1275k																
2475b	2475c	2375	.....	3250c	3825f	130	32x4½	Own..	6-3½x5¼	29.40	National BB	Rayfield	West	Delco	s-p	B&B	B-L	m	Arvac	F	Col	4.08
		3150		3725c																	
2500	2500c	2600c	.....	.....	3500d	128	32x4½	Cont..	6-3¼x4½	25.35	Noma 3C	Claudel	Delco	Delco	s-p	B&B	Detr	m	Spicer	½F	Tim	4.45
3000	3100c	3200c	.....	.....	5500	128	32x4½	Bea..	6-3½x5¼	29.40	Noma 1D	Zenith	Delco	Delco	s-p	B&B	Detr	f	Spicer	½F	Tim	4.45
.....	1035	.....	.....	.....	.....	116	32x3½	Lyc..	4-3½x5	19.60	Norwalk 430-KS	Zenith	Dyneto	Delco	s-p	B&B	G-L	m	Univers	¾F	Col	5.00
975	995	795g	1165c	1445d	1545	115	32x4	Own..	6-2¹¹⁄₁₆x4¾	18.99	Oakland 6-44	Marvel	Remy	Remy	c	Own	Muncie	m	Mech	F	Own	4.33
				1185a																	
3750c	3750	3850	3750c	4500c	4800f	134	33x5	Cont..	6-3⅝x5¼	31.54	Ogren 6 T D Luxe	Rayfield	Bosch	Bosch	m-d	B-L	B-L	m	.....	F	Col	4.00
955	975	1350d	1075	1475	1595	115	32x4	Own..	4-3½x5½	21.86	Oldsmobile 43 A	Zenith	A-L	Remy	s-p	B&B	Warner	m	Own	¾F	Own	4.33
1735c	1850c	1735	.....	.....	.....	122	33x4½	Own..	8-2⅞x4¾	26.45	Oldsmobile 46	Ball&B	Delco	Delco	c	Own	Warner	m	Own	¾F	Own	4.93
1625p	1375	.....	1675	1875	2025	115	32x4	Own..	8-2⅞x4½	26.45	Oldsmobile 47	Johnson	Delco	Delco	s-p	B&B	Warner	m	Spicer	¾F	Own	5.10
525	525	.....	425g	795	875	100	30x3½	Own..	4-3⅜x4	18.23	Overland 4	Till	A-L	Conn	s-p	B&B	Own	m	Own	½F	Own	4.50
2485	2485	2250g	.....	3175	3275	126	33x4½	Own..	6-3⅜x5	27.34	Packard Single-Six	Own	A-K	Delco	m-d	Own	Own	f	Spicer	½F	Own	4.30
.....	2350g	2685	.....	.....	3525	133	33x4½	Own..	6-3⅜x5	27.34	Packard Single-Six	Own	A-K	Delco	m-d	Own	Own	f	Spicer	½F	Own	4.66
3850	3850	3850	.....	5240	5400	136	35x5	Own..	12-3x 5	43.20	Packard Twin-Six	Own	Bijur	Delco	m-d	Own	Own	m	Spicer	½F	Own	4.36
1465	1465	1290g	.....	1995	2245	119	32x4	Own..	6-3¼x5	25.35	Paige 6-44	Strom	Remy	A-K	s-p	Long	Own	m	Univers	¾F	Salis	4.75
2495b	.....	2195	2245	3100	3155	131	33x4½	Cont..	6-3⅜x5	33.75	Paige 6-66	Rayfield	Remy	A-K	s-p	Long	Warner	m	Mech	¾F	Tim	4.60
.....	1390	1425	.....	2395	2395	120	32x4½	Cont..	6-3⅜x4½	27.34	Paterson 22-6-52	Strom	Delco	Delco	s-p	B&B	Durst	m	Hartford	½F	Std	4.50
.....	2990c	2990	.....	3300a	3990d	128	33x5	Own..	8-3¼x5	33.80	Peerless 23	Ball&B	Delco	Delco	m-d	Own	Own	M	Spicer	¾F	Tim	4.90
				3100c	4090f																
5250	5250c	5250	.....	6800	6900	138	33x5	Own..	6-4 x5½	38.40	Pierce-Arrow	Own	Delco	Delco	m-d	Own	Own	m	Spicer	½F	Own	3.93
					700																
2050	2000	2050	.....	2950	3000	126	32x4½	H-S..	6-3¼x5	25.35	Pilot 6-50	Till	Bijur	Conn	s-p	B&B	Muncie	m	Hartford	¾F	Col	4.33
3150	3100c	3250	.....	4300	5100	126¾	32x4½	Own..	6-3⅜x5½	27.34	Premier 6-D	Johnson	Delco	Delco	s-p	B&B	Own	m	Spicer	¾F	.....	4.58
1095	1095	.....	.....	1750	1825	117	32x4	Falls..	6-3½x4¾	23.44	Premocar 6-40-A	Strom	Wagner	Wagner	s-p	B&B	Mech	m	Spicer	¾F	.....	4.66
.....	1665	.....	.....	2385	2475	116	32x4	Own..	4-3⅜x5	22.50	R & V Knight R	Strom	Wagner	Wagner	s-p	B&B	B-L	m	Spicer	F	Salis	4.75
2475	2475c	2475	.....	3015	3105	127	32x4½	Own..	6-3½x4½	29.40	R & V Knight J	Strom	Wagner	Wagner	s-p	B&B	B-L	m	Spicer	½F	Tim	4.90
1595	1645	1485	1745	2355c	2435f	120	33x4	Own..	6-3⅛x5	24.34	Reo T6 & U6	Rayfield	N.E	N.E	m-d	Own	Own	m,f	Own	½F	Own	4.70
3200	3200	3200	.....	.....	4000	131	32x4½	Dues..	4-4¼x6	28.90	ReVere C	Strom	West	Bosch	m-d	B-L	B-L	m	Spicer	¾F	Std	4.00
.....	1485	.....	.....	1885	1985	117	32x4	Own..	6-3½x4¾	23.44	Rickenbacker A	Strom	Simms	A-K	c	Own	Own	m	Univers	¾F	Own	.....
2685	2485c	2635	.....	3585	3585	128	32x4½	Cont..	6-3½x5¼	29.40	Roamer 6-54-E	Strom	Bijur	Bosch	s-p	G-L	G-L	f	Snead	½F	Tim	4.88
3785	3485	3650c	3650c	.....	4650c	128	32x4½	Dues..	4-4¼x6	28.90	Roamer 4-75-E	Strom	Bijur	Split	m-d	B-L	B-L	f	Snead	½F	Tim	3.77
.....	10900	.....	.....	.....	.....	143½	35x5	Own..	6-4½x4¾	48.60	Rolls-Royce	Own	Bijur	Bijur	c	Own	Own	m	Own	F	Own	3.25
1195	1195	.....	.....	1795	1795	112	32x4	Own..	4-3½x5	19.60	Saxon 125	Strom	Wagner	Wagner	s-p	Det	Cov	m	Peters	¾F	.....	4.75
1645	1645	.....	.....	2645	2645	118	33x4	Cont..	6-3¼x4½	25.35	Sayers Six DP	Strom	Delco	Delco	s-p	B&B	G-L	m	Arvac	½F	Std	4.75
875	875	.....	.....	.....	.....	108	30x3½	Lyc..	4-3½x5	19.60	Seneca L-2 & O-2	Zenith	A-L	A-L	s-p	B&B	G-L	m	Univers	F	.....	4.75
1095	1095	.....	.....	.....	.....	112	31x4	Lyc..	4-3½x5	19.60	Seneca 50 & 51	Zenith	A-L	A-L	s-p	B&B	G-L		Detroit	F	.....	4.50
980	980	.....	.....	1685	1685	114	32x4	Supr..	4-3⅜x5	18.23	Sperling A	Zenith	Bijur	Dixie	s-p	B&B	Warner	m	Hartford	¾F	Peru	.....
2150	.....	2395	2395	2750	3200	127	34x4½	Own..	8-3¼x5	33.80	Standard 98	Zenith	West	Split	s-p	B&B	G-L	m	Arvac	½F	Tim	4.45
2750	2750	2750	2425g	3950c	3985f	130	32x4½	Own..	2-4 x5	.....	Stanley 740	None	Bijur	None	None		None	None		½F	Own	1.50
1765	1765	.....	.....	2750	.....	118	33x4	Cont..	6-3¼x4½	25.35	Stanwood Six	Strom	West	A-K	s-p	B&B	G-L	m	Peters	½F	Std	4.50
319r	348s	285g	.....	580	615	102	30x3½	Cont..	4-3½x4¼	15.63	Star	Till	A-L	A-L	s-p				Spicer		Tim	4.87
2250	2250	2450	.....	3150	3150	125	34x4½	Own..	4-3¾x5⅝	22.50	Stearns-Knight SKL4	Rayfield	West	A-K	m-d	Own	Own	f	Climax	½F	Own	4.50
2700	2700	2850	.....	3500	3730	130	34x4½	Own..	6-3⅜x5	27.34	Stearns-Knight 6	Rayfield	West	A-K	m-d	Own	Own	f	Climax	½F	Own	4.50
1575	1595c	1625c	.....	2450	2550	122	33x4½	Own..	6-3¼x4½	25.35	Stephens 90	Till	A-L	A-L	s-p	B&B	Mech	m	Mech	½F	Tim	4.90
7250	6900c	6800	6900c	8600	8900c	138	35x5	Own..	6-4⅞x5½	47.27	Stevens-Duryea E	Strom	West	Bring	m-d	Own	Own	m	Own	F	Own	3.94
			5800g																		
975	975	785g	.....	1225	1550	112	32x4	Own..	6-3¼x4½	23.44	Studebaker Light Six	Strom	Wagner	Wagner	s-p	Own	Own	f	Thermoid	½F	Own	4.55
1250	1275	1275c	1000g	1875	2055	119	32x4	Own..	6-3½x5	29.40	Studebaker Special Six	Strom	Wagner	Wagner	s-p	Own	Own	m	Spicer	½F	Own	4.00
1275c																					
1300g	1650	.....	1785	2275	2475	126	33x4½	Own..	6-3⅞x5	36.04	Studebaker Big Six	Ball&B	Wagner	Wagner	s-p	Own	Own	m	Spicer	½F	Own	3.70
2450	2790c	2640c	2670a	3490	4450	130	32x4½	Own..	4-4⅝x6	30.63	Stutz KLDH	Strom	Remy	Delco	m-d	Warner	Own	m	Hartford	½F	Own	3.50
	3165c	3015																			
2025	2125	2175c	.....	2650c	2785	118	32x4	Own..	4-3⅜x5½	18.23	Templar A-445	Strom	Bijur	Simms	s-p	B&B	Detr	f	Snead	½F	Us	4.40
1175	1175	.....	.....	.....	.....	117	33x4	H-S..	4-3½x5	19.60	Tulsa E-1-2-3	Zenith	Dyneto	Conn	s-p	B&B	Muncie	m	.....	F	Salis	4.50
1275	1275	.....	1305	1785	1785	115	32x4	Own..	6-3½x4½	23.44	Velie 58	Strom	West	A-K	s-p	Dooley	Durst	m	Thiemer	¾F	Own	4.66
.....	1990f	1890	.....	.....	2890	125	32x4½	Cont..	6-3½x5¼	29.40	Westcott D-48	Rayfield	Delco	Delco	s-p	B&B	B-L	m	Peters	½F	Tim	4.45
.....	1690	.....	1890	.....	2690	120	32x4	Cont..	6-3¼x4½	35.35	Westcott B-44	Rayfield	Delco	Delco	s-p	B&B	Warner	m	Peters	½F	Col	4.33
2475	2475	.....	.....	3275	3475	121	32x4½	Own..	8-3¼x4	33.80	Wills Sainte Claire A-68	Zenith	Delco	Delco	m-d	Own	Own	m	Mech	¾F	Own	4.45
1235	1235	1375	.....	1795	1950	118	32x4	Own..	4-3⅝x4½	21.03	Willys-Knight 20	Till	A-L	A-L	m-d	Own	Own	f	Own	¾F	Own	4.44
3400	.....	3400	3600	4000	4550	132	33x5	Own..	6-3¾x5¼	33.75	Winton 40	Rayfield	Delco	Delco	m-d	Warner	Warner	f	Climax	¾F	Tim	4.68

MISCELLANEOUS
a—2 Passenger,
b—3 Passenger,
c—4 Passenger,
d—5 Passenger
e—6 Passenger,
f—7 Passenger
g—Chassis Price,
h—All Metal Type,
k—Soft Top Type,
n—Tire Size 32x4½,
p—Sport.
r—Price without starter and demountable rims. Price, complete, $414.
s—Price without starter and demountable rims. Price, complete, $443.
†Standard Phaetons.

ENGINE
Anst—Ansted
Bea—Beaver
Cont—Continental
Curt—Curtiss
D-Ly—Dort Lycoming
G-B—Grey Beal
H-S—Herschell-Spillman
Lyc—Lycoming
Nort—Northway
Roch—Rochester
Rut—Rutenberg
Supr—Supreme
Walk'r—Walker
Weid—Weidely
Wisc—Wisconsin

CARBURETOR
Ball & B—Ball & Ball
Till—Tillotson
Strom—Stromberg

GEARSET
f-d—Friction Drive
B-L—Brown-Lipe
Cov—Covert
Detr—Detroit
Durst—Durston
G-L—Grant-Lees
Hoos—Hoosier
Mech—Mechanics
North—Northway

STARTING, LIGHTING IGNITION
A-L—Auto Lite
Bring—Berling
G-D—Gray & Davis
L-N—Leece Neville
N. E.—North East
West—Westinghouse

CLUTCH
c—Cone
f-d—Friction drive
m-d—Multiple disc
s-p—Single plate
Anst—Ansted
B & B—Borg & Beck
B-L—Brown-Lipe
Det—Detlaff
Detr.—Detroit

UNIVERSAL
f—fabric
m—metal
M&E—Merchant & Evans
Mech—Mechanics
Sterl—Sterling
Univers—Universal

REAR AXLE
F—Floating
½ Floating—Semi-Floating
¾F—Three-Quarter Floating
Col—Columbia
Salis—Salisbury
Std—Standard
W-M—Weston-Mott
Tim—Timken